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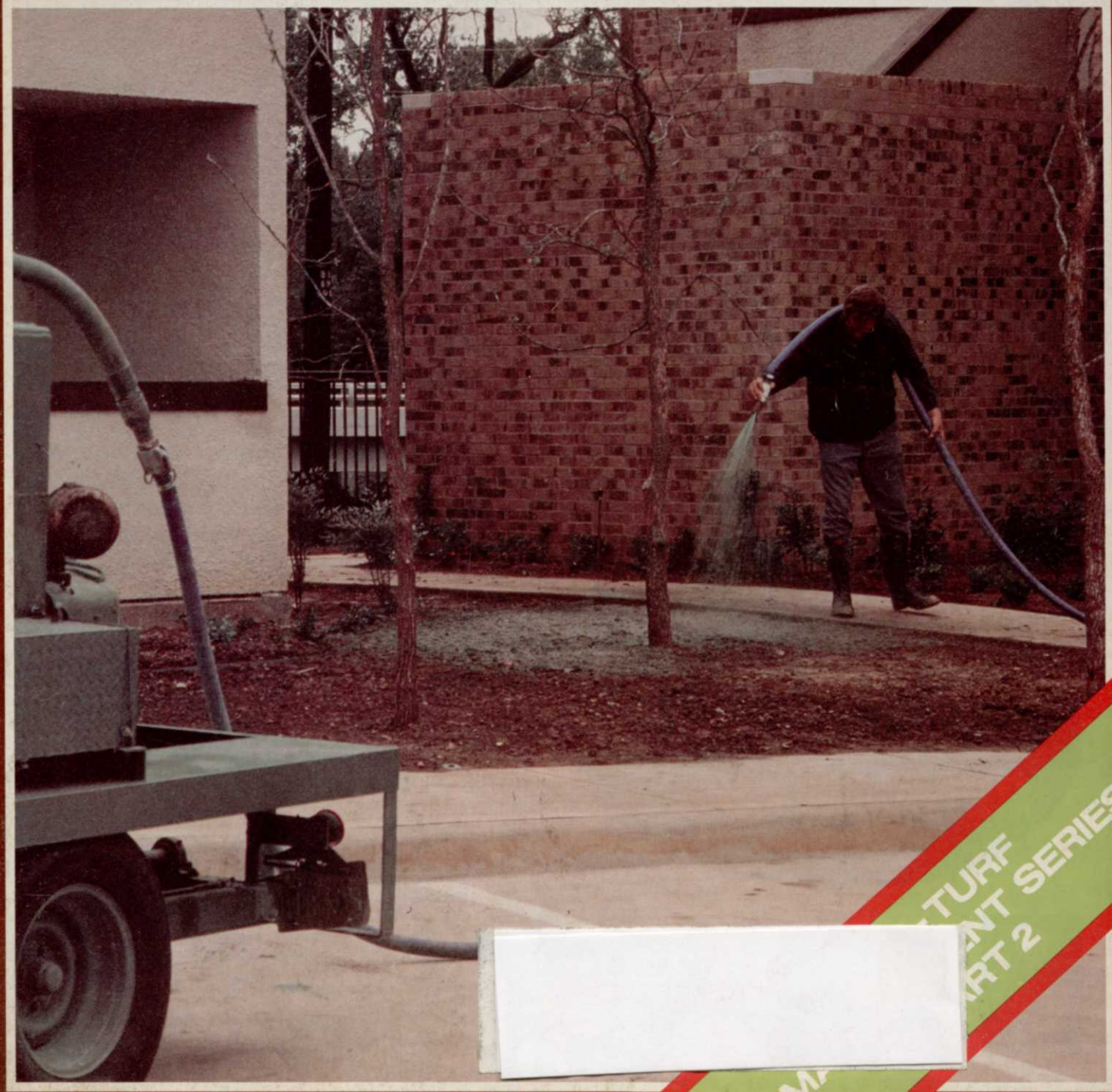
WEEDS TREES & TURF

Turf Pavers and Special Maintenance Needs

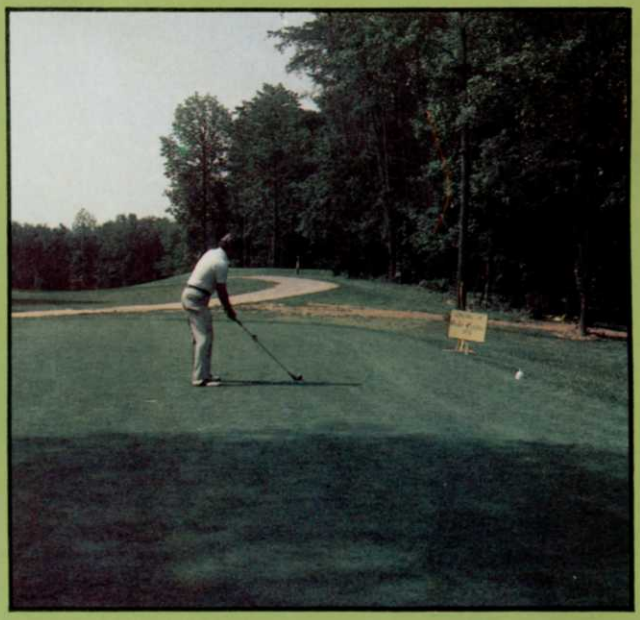
Urban Tolerance Gives Oaks Edge

Mulches for Erosion Control on Disturbed Sites



ISSN 0043-1753

Pair for the Course



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OUTLOOK

By Bruce F. Shank, Editor

The organizational needs of athletic field managers are growing and existing Green Industry associations should consider whether or not they can be of service.

The influence of an athletic field manager currently depends more on the success of and the support for the teams that play on the fields than on the agronomic needs of the turf. Like other Green Industries, the athletic field manager has to educate his superiors to the needs of natural turf and to the waning popularity of artificial turf.

To think that trustees could be sold on the concept of expensive artificial turf, but hesitate to allocate funds for the proper care of natural turf is ironic. There is a definite need to educate financial managers of athletic fields about the advances in turf management.

There is a choice. We can leave the task of educating the financial officer to the product salesman, or we can assist athletic field managers in establishing specifications for quality athletic field construction and maintenance. No doubt specifications do exist in the files of some landscape architects, but they come from numerous sources and may have outdated concepts in design. One organization needs to compile such specifications for the various climatic zones of the country, officially approve them, and release them to all landscape architects and stadium managers. Extension turf specialists from across the U.S. should assist in constructing specifications with the input of athletic field managers for practicality. What is best may not be practical, but minimum standards must be clearly defined.

Whether this task requires the creation of another Green Industry association is debatable. It depends upon the willingness of existing associations to help out.

For the most part, the athletic field manager is an employee, not the owner of a business. His needs are different from business owners. Dues must be reasonable and the organization must be national in scope. Suppliers to athletic field managers usually have booths at the major shows and may resist participating in another show until proof of organizational viability and market support exists.

I am not recommending the formation of a new group nor do I mean to discourage it. The horizontal identity of the Green Industry is most important. Segmentation should only take place when clearly needed.

So, we encourage present associations to evaluate their position regarding athletic managers and write their views to this magazine for publication. We also encourage those involved in athletic field management; whether they be managers, suppliers, or extension personnel; to send their view to Weeds Trees & Turf for publication.

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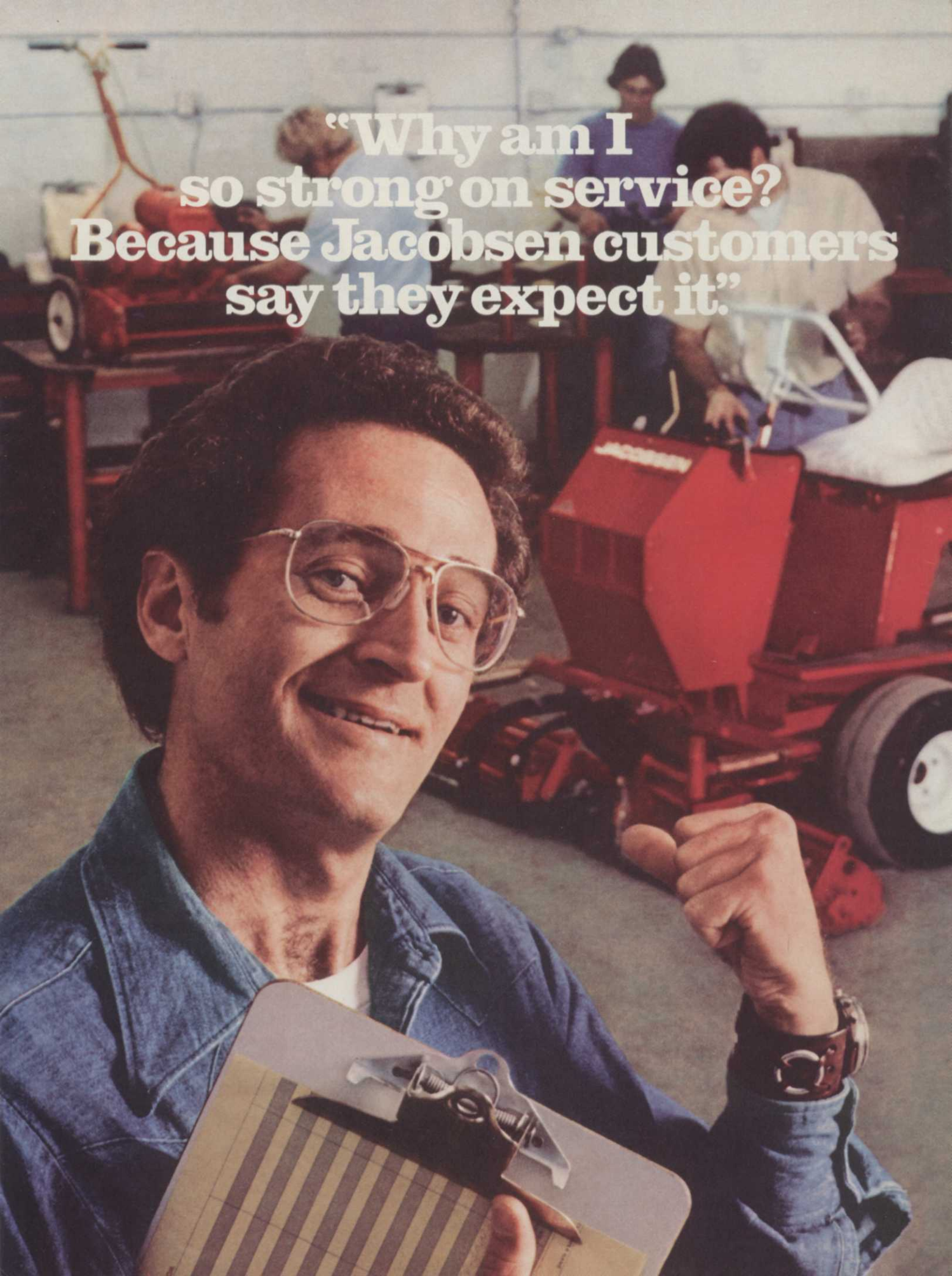
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GREEN INDUSTRY NEWS

Industry leaders decry proposed spray ban

A national outcry has emerged from Green Industry leaders and representatives over a petition to severely limit spraying of pesticides.

The petition, submitted in May, 1979 by Friends of the Earth (FOE) to the Environmental Protection Agency and the Federal Aviation Administration received some 4,000 responses. It requests that pesticide labels prohibit aerial and ground rig application unless the applicator obtains advance written permission from people who live or own property within a given distance of the spray area boundary.

It has evoked a vehement response to industries involved in spraying. For some, the petition could mean an almost complete shutdown of work. To others, it represents another of a series of environmentalist efforts to halt the use of pesticides.

One reason the industry feels particularly victimized by the joint EPA/FAA petition is that it was published under the Proposed Rules section of the January 17 Federal Register. It should have appeared in the Notices section. EPA has received a number of communications from people who have seen or heard of the Federal Register notice and are concerned the EPA is proposing to comply with it.

Beyond this bumble, though, the petition angers Green Industry members because it suggests a dramatic change in their operation. It would require any applicator to receive permission when spraying within 250 feet of a lot with ground equipment and 1,000 feet when applying with mist blowers or aerial applicators.

According to the American Association of Nurserymen, the proposal would mean garden center or landscape nurseries would have to be in excess of 1.4 acres before there would be one square foot that could be treated without permission. With mist blower sprayers or aerial applicators, it would require at least 22.95 acres in a perfect square before there would be any land free of adjacent property owners.

In the East and other areas where properties are particularly close, the proposal would indirectly stymie the use of pesticides, the actual goal of the petition, according to a Cornell University researcher. He foresees a full array of new insect, disease, and weed problems on golf courses, parks, forest lands, and most farms.

"The 250-feet range makes it necessary for maybe five approvals on each side," says Maria Cinque, extension agent for Nassau County, NY. "I think many of the urban areas will have this problem. The danger is that if only one person says no, all spraying could be stopped."

An official from the Associated Landscape Contractors of America says that landscapers providing guarantees would be affected and maintenance contracts would be severely impacted. If a contractor can't spray trees or shrubs or has to revert to a cumbersome spraying process, the more labor involved will multiply the costs of treatment.

Arborists are also very concerned about the potential effects of the petition. Earl Sinnamon, chairman of the NAA's pesticide committee, says there is no way to spray tall trees without some drift. Executive Secretary Bob Felix says that arborists recognize the problem and see alternatives. "We are continuing our aggressive pursuit of Integrated Pest Management strategy," he says. "We should be looking down the road with that eventuality coming upon us."

No decisions will be made on the Friends of the Earth petition for several months. The EPA and particularly the FAA are reviewing the approximate 4,000 comments received with close scrutiny. They realize it is a highly polarized issue with broad implications.

When the federal agencies received the petition, they already had undertaken programs to resolve the whole question of spray drift. And when it comes time to decide on a policy, the agencies may not even mention the Friends of the Earth. Yet the FOE petition, for all its publicity, may serve to unite the Green Industry. It will be time to write again when the federal agencies ask for comments on the general rule it proposes.

Throwing the switch to a 60-foot windmill which will generate energy for a solar greenhouse is Cal Poly's president, Dr. Warren J. Baker. Others, from left, are Ronald Regan, head of the Ornamental Horticulture Department; Dr. Howard C. Brown, dean of the School of Agriculture and Natural Resources; and Marshall Ochylski, ornamental horticulture faculty member.

GOLF

McLoughlin named GCSAA exec director

James E. McLoughlin has been chosen as the new Executive Director of the Golf Course Superintendents of America, said GCSAA President Melvin B. Lucas Jr.

McLoughlin is well known in the national golf community, having served as executive director of the prestigious Metropolitan Golf Association since 1966. He will begin his duties with GCSAA this September.

Lucas said, "The future welfare of the golf, club, and turf industries will require greater communications among all golf-related organizations in the years ahead, and often, a common effort. Jim McLoughlin's diversified background will facilitate GCSAA's support of this concept."

McLoughlin has served on the board of governors and is currently a member of the National Club Association's long range planning committee. He is a past president of the International Association of Golf Administrators and is chairman of its national liaison planning committee. He cofounded and served on the faculty of the Manhattanville College Club Management Program, a continuing education program designed specifically for the golf club community, which has been attended by many golf course superintendents.

IRRIGATION

Symposium planned for Nebraska Center

The Second National Irrigation Symposium has been scheduled at the Nebraska Center for Continuing Education (NCCE), University of Nebraska, Lincoln for October 20-23.

The program will include presentations on current irrigation practices, irrigation development during the 70's, current significant research, and potential future developments.

HONORS

Chemical Association elects new chairman

The Chemical Manufacturers Association (CMA) recently elected H. Barclay Morley, chairman of the board and chief executive officer of

LANDSCAPE CONTRACTOR NEWS

Interior Landscape will meet in Denver

"Prospering in an Uncertain Economy" is the theme of the 1980 Interior Landscape Conference scheduled for the Fairmont Hotel in Denver, Sept. 10-13.

A wide range of speakers will discuss the economic climate's impact on interior landscape firms, foliage technology, personnel administration, promotion, and selling. The conference will also feature a business meeting and presentation luncheon, at which exhibiting firms will show new developments in their products and/or services.

At least 50 leading suppliers and manufacturers will display their products and services for the industry at the trade exhibit on Thursday. Program chairmen are expecting a record turnout, possibly 400 people.

Complete information and registration materials for the 1980 Interior Landscape Conference of ALCA is available from: Interior Landscape Div., 1750 Old Meadow Road, McLean, VA 22102, 703/821-8611.

Author to address California landscapers

Author William Whyte will keynote the 1980 California Council of Landscape Architects annual conference scheduled for October 19-21 at the Asilomar Conference Center on the Monterey Peninsula.

White, who wrote "The Social Life of Small Urban Spaces," will show a film he made of New York street life which analyzes public places and why people do or don't use them.

Panels will provide discussion on resource conservation and licensing and legislation. Other topics include microclimate modification for human comfort and a presentation by Sunset Magazine on problems landscape architects have preparing photos for publication.

For more information, contact conference chairpersons Leah Haygood (415/841-5154) or Deb Mitchell (415/821-3500).

Productivity marks ASLA board meeting

The American Society of Landscape Architects' Board of Trustees covered a multitude of items at its mid-year meeting held in Kansas City during May.

The discussion included the new headquarters building, membership, unification with the American Institute of Landscape Architects and changes in the constitution and "Emeritus Status" bylaw. Executive Director Ed Able reported that in the past 12 months, ASLA membership has increased 14.2 percent, and the current number of dues-paying members stands at 4,876.

ALCA's Interior Div. names chairman

The Associated Landscape Contractors Interior Landscape Division installed a new chairman and embarked on its first full year of operation as an independent arm of ALCA at the group's 1980 annual meeting in San Diego.

Laine Craft, owner/manager of Living Interiors, Lake Park, FL, was installed as chairman of the I.L. for 1980.

According to Craft, I.L.D. programs for the year include: several one-day interior Maintenance Technicians Short Courses, management-oriented seminars, and the first annual Interiorscape Conference this fall in Denver.

GOVERNMENT UPDATE

Senate panel votes for chemical cleanup

The Senate Environment Committee recently approved a tough hazardous waste bill which would force chemical companies to annually contribute $700 million to a new federal superfund.

The bill would open chemical companies and their customers to a new round of government and private lawsuits over damage caused by toxic waste spills around the country. It is much tougher than an earlier bill proposed by the House Commerce Committee.

The measure would impose "strict liability" for damages—which means that plaintiffs wouldn't have to prove that negligence was involved in a waste spill—on companies that contributed to a hazardous emission. Such suits could be filed against the owners or operators of dump sites, the companies that generated the waste or contracted for its disposal, or the concerns that transported it.

A spokesman for the Chemical Manufacturers Association said that the Senate is asking the chemical industry to cover for 17 industries, such as hospitals, and steel mills, and others involved with chemicals. A new company would have to contribute to cleanup of pre-existing spills.

Mondale, Bergland dedicate herb garden

Joan Mondale, honorary chairwoman of the Federal Council on the Arts and Humanities, and Secretary of Agriculture Bob Bergland dedicated the new National Herb Garden at the U.S. Department of Agriculture's National Arboretum in Washington, D.C.

In the dedication, Mondale placed the final plant, a dwarf blue cypress, into an intricately patterned knot garden, one of the major features of the garden. The herb garden covers about two acres in a meadow of the 444-acre arboretum.

Bergland said the Herb Society of America raised over $300,000 for the garden, which was then supplemented by $200,000 in federal funds.

Senate acts to perk interest in patents

To stimulate both production and innovation, the Senate recently passed a measure that would allow small businesses to retain title to inventions they develop using federal research funds.

Under current law, the government owns more than 28,000 patents, but of that number, only 4% have been commercially exploited. Business owners complain that investments in new product developments are unattractive without exclusive rights to the patents. While some government agencies award exclusive licenses, others do not.

EPA asks ban on most uses of lindane

The Environmental Protection Agency has proposed to ban most uses of lindane, a pesticide used in a number of household products, in agriculture, and for treating hardwood logs and lumber.

The agency has invited Hooker Chemicals and Plastics Corp. of Niagara Falls, NY, the only U.S. manufacturer of lindane, and other interested parties to comment on the proposal.

Some of the areas EPA would ban lindane use are: all seed tr eatments, Christmas trees, home applications on ornamental plants and trees, in forestry, and on hardwood logs, lumber, and in structures.

Stauffer Chemical Co., as its new chairman of the board. It also honored The Dow Chemical Company, Midland, MI, and Virginia Chemicals, Inc., Portsmouth, VA, for the 1980 Safety Awards at its annual meeting in White Sulphur Springs, WV.

William G. Simeral, senior vice president of E.I. du Pont de Nemours & Company, was elected vice chairman of the board.

Paul F. Oreffice, president and chief executive officer of the The Dow Chemical Company, was elected chairman of the executive committee.

Robert A. Roland was re-elected president of the association, and 19 members were newly elected to the board of directors.

The awards are made to CMA member companies that show the greatest percentage reduction rates of occupational injuries, deaths, and illnesses in a five year span. The Dow Chemical Company led the larger company category with 57 percent injury reduction, and Virginia Chemicals had 38 percent reduction in the smaller company category.

CMA is also presently planning for the 1981 awards to high school, two-year and four-year college chemistry and chemical engineering teachers. United States and Canadian teachers with a minimum of 10 years teaching experience are eligible for the national awards.

Nominations must be received by CMA by Feb. 1, 1981. For further information contact Dr. Robert E. Varnerin, CMA, 1825 Connecticut Ave., N.W., Washington D.C. 20009.

PLANTS

GCA Survey shows foliage plant sales up

Overall sales of foliage plants increased last year, according to the 70 firms responding to a management survey taken by Garden Centers of America (GCA) in February.

Thirty-seven percent of these firms showed increases between 10 and 25 percent; however, 59 percent of the respondents said such sales represent 10 percent or less of their total 1979 sales.

When asked by GCA members what size plants make better sales items, the retailers' response was: plants in 6-10 inch pots are 26 percent; 3-6 inch pots 21 percent; 3 inch

Continues on page 63

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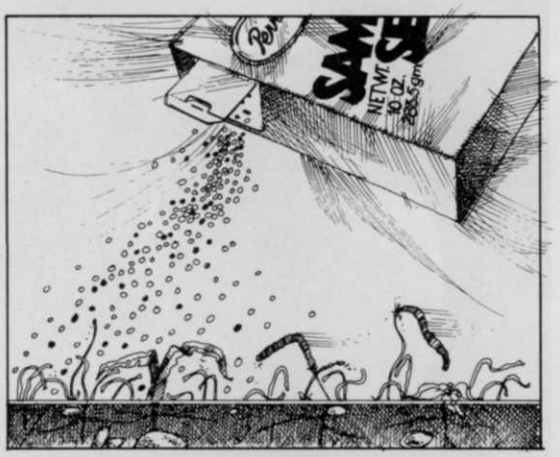

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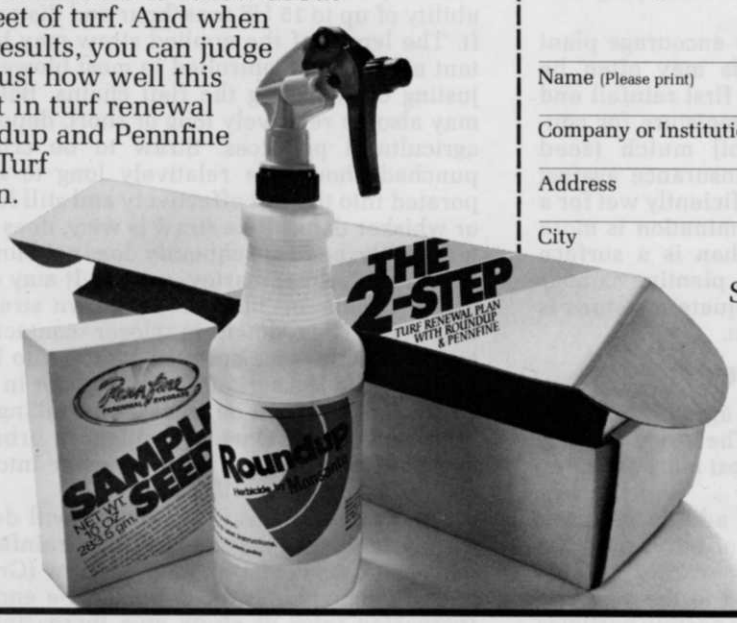

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MULCH CHOICES FOR EROSION CONTROL AND PLANT ESTABLISHMENT

By Burgess L. Kay, Department of Agronomy and Range Science, University of California, Davis

Reprinted with permission from the Associated Landscape Contractors of America Revegetation Report, 1978. This highly informative collection of papers on erosion control is available from ALCA, 1750 Old Meadow Rd., McLean, Virginia, 22102 for the price of $14 (members price less).

Mulching nearly always shortens the time needed to establish a suitable plant cover. The conventional mulches of agricultural or industrial residues have recently encountered competition from many chemical stabilizers or mulches introduced largely as supplements to the increasingly popular hydraulic methods (hydroseeding — application of a water slurry of seed, fertilizer, mulch, etc.).

Seed coverage with soil to the proper depth is essential in dry regions. Mulch, particularly hydromulching, is sometimes substituted for seed coverage when moisture is adequate. Showing the most promise in excessively dry areas are mulches applied after seed has been covered to the proper depth with soil, as with a grain drill (Springfield 1971).

Mulches can both protect soil and enhance plant establishment. The soil is protected by shielding it from raindrop impact, retarding water flow and soil movement by trapping silt on the sites, increasing water penetration, and sometimes shedding water. Properly anchored, mulches may reduce wind velocity. They enhance plant establishment by holding seed and fertilizer in place, retaining moisture, preventing crusting, and modifying temperatures.

Mulches on dry sites may also encourage plant suicide! Properly mulched seeds may often be fooled into germinating with the first rainfall and soon die from lack of sufficient moisture for continued growth. The use of soil mulch (seed coverage) is probably the best insurance against such a calamity. Soil which is sufficiently wet for a long enough period to effect germination is more likely to sustain plant growth than is a surface organic mulch or chemical. Also, planting as near as practical to a date when adequate moisture is expected may avoid this problem.

ORGANIC MULCHES

Organic mulches are often an agricultural crop residue or industrial product. The price usually reflects transport and handling cost more than any intrinsic value of the product.

Most organic mulches require additional nitrogen to compensate for the tie-up of nitrogen in the decomposition process.

Effectiveness is roughly related to the size and shape of the mulch particles. Long narrow particles are superior to finely ground products. Following is a discussion of the organic mulches commonly used.

Straw and Hay

Straw and hay are the mulches used most often in the West. Cereals are a major crop in dry regions of the United States, and straw left on the site of production is often considered a liability because its decomposition ties up nitrogen needed for the next crop. Straw availability should be increased by current restrictions on removing this crop residue by burning in place. Clean grain straw, free of noxious weeds, is preferred. The straw can be expected to contain 0.5 to 5.0% cereal seed by weight, which may result in considerable plant cover in the first year. This provides additional erosion protection but may also be prohibitively competitive with the planted erosion-control or beautification mixture. Rice straw is sometimes used because neither the rice nor associated weeds can be expected to grow on most unirrigated disturbed lands. In areas where cereal crops are not common, hay is sometimes used but is normally more expensive than straw. Wild Grass hay may be a valuable source of native plant material if cut when the seeds are ripe but not shattered.

The mulch effect of straw can be expected to increase plant establishment. Meyer et al. (1971) obtained fescue-bluegrass establishment of 3, 28, and 42% with respective surface straw mulch treatments of 0, 1, and 2 tons/acre. Comparisons of straw with hydromulch show that straw mulch produced the best grass stands (Kay, 1974; Perry et al., 1975).

Straw can be applied with specially designed straw blowers or spread by hand. Commercial mulch spreaders or straw blowers advertise a capability of up to 15 US tons/hour and distances to 85 ft. The length of the applied straw may be important and can be controlled in most blowers by adjusting or removing the flail chains. Baled straw may also be relatively long or short, depending on agricultural practices. Straw to be crimped or punched should be relatively long to be incorporated into the soil effectively and still leave tufts or whisker dams. Rice straw is wiry, does not shatter readily, and consequently does not blow as well as straw of wheat, barley, or oats. It may come out of the blower in 'bird nests'. Blown straw (other than rice) lies down in closer contact with a tackifier (substance sprayed on straw to hold it in place). Wind is a serious limiting factor in applying straw, though it can be an asset in making applications downwind. Dust, a problem in urban areas, can be overcome by injecting water into the airstream used to blow the straw.

The amount of straw to be used will depend on the erodability of the site (soil type, rainfall, length and steepness of slope), kind of straw (Grib, 1967), and whether plant growth should be encouraged. Increasing rates of straw give increasing protection. Meyer et al. (1970) show that as little as 1,000 lb/acre reduced soil losses by two-thirds, while 4 US tons/acre reduced losses by 95%. Straw to be

crimped is commonly used at 2 US tons/acre, while straw punched into fill slopes in California is at 4 US tons/acre each. Straw to be held down with net should be limited to 1.5-2 US tons/acre, and straw held with a tackifier at 1-1.5 US tons/acre if plant growth is important. Too much straw may smother seedlings by intercepting all light or forming a physical barrier. Also, some grass straw (notably annual ryegrass, *Lolium multiflorum)* may contain inhibitors that have a toxic effect if used in excess. A good rule of thumb is that some soil should be visible if plant growth is wanted. Higher rates of straw may still satisfy these requirements if the straws are vertically oriented (like tufts) by crimping or punching. Excessive straw on the surface may be a fire hazard.

Straw or hay usually needs to be held in place until plant growth starts. The problem is wind, not water. Water puddles the soil around the straw and helps hold it in place. Also, methods of holding straw in place are crimping, disking, or rolling into the soil; covering with a net or wire; or spraying with a chemical tackifier. Swanson et al. (1967) found similar protection from prairie hay applied as a loose mulch or anchored with a disk packer (crimper).

Crimping is accomplished with commercial machines which utilize blunt notched disks which are forced into the soil by a weighted tractor-drawn carriage. They will not penetrate hard soils and cannot be pulled on steep slopes.

Rolling or "punching" is done with a specially designed roller. A sheepsfoot roller, commonly used in soil compaction, is not satisfactory for incorporating straw. Specifications of the California Department of Transportation contain the following provisions (State of Calif. 1975): "Roller shall be equipped with straight studs, made of approximately 7/8 inch steel plate, placed approximately 8 inches apart, and staggered. The studs shall not be less than 6 inches long nor more than 6 inches wide and shall be rounded to prevent withdrawing the straw from the soil. The roller shall be of such weight as to incorporate the straw sufficiently into the soil so that the straw will not support combustion, and will have a uniform surface."

The roller may be tractor-drawn on flat areas or gentle slopes, whereas on steeper slopes with top-of-slope access the roller may be lowered by gravity and raised by a winch in yo-yo fashion, commonly from a flat-bed truck. Requirements are soil soft enough for the roller teeth to penetrate, and access to the top of the slope. This is a common treatment of highway fill slopes in California. It can be used on much steeper slopes than a crimper. Punched straw may not be as effective as contour crimped straw, because of the staggered arrangement of tucked straw instead of the "whisker dams" made by crimping (Barnett et al., 1967).

A variety of nets have been used to hold straw in place: twisted-woven kraft paper, plastic fabric, poultry netting, concrete reinforcing wire, and even jute. Price and the length of service required should determine the product used. These should be anchored at enough points to prevent the net from whipping in the wind, which rearranges the straw.

Perhaps the most common method of holding straw, particularly in the eastern U.S., is use of a tackifier. This method may be used on relatively steep slopes which have limited access and soil too hard for crimping or punching. Asphalt emulsion, the tackifier used most commonly, is applied at 200-500 gal/acre—either over the top of the straw or applied simultaneously with the straw blowing operation. Recent tests (Kay, 1976) have shown that 600 gallons is superior to 400 gallons, and that 200 gal/acre is not satisfactory. Wood fiber, or new products used in combination with wood fiber, have been demonstrated to be equally effective, similar in cost, and environmentally more acceptable. Terratack I is a gum derived from guar, Terratack II is semi-refined seaweed extract, and Ecology Controls M Binder is a gum from plantain, *Plantago insularis.* The remaining products are emulsions used in making adhesives, paints, and other products. Though wood fiber alone is effective as a short-term tackifier, glue must be added to give protection beyond a few weeks. Increasing the rate/acre of any of the materials will increase their effectiveness.

Hydraulic mulching

Hydraulic mulching, or hydromulching, is a mulch applied in a water slurry. This same slurry may also contain seed, fertilizer, erosion-control compounds, growth regulators, soil amendments, etc., and is increasingly popular because of low labor requirements. Mulches must have a particle size small enough for ready pumping through 0.5-inch nozzles, and must not be too buoyant to remain in suspension with moderate agitation. Used most commonly are specially manufactured fibers of alder and aspen. Hemlock, also used, is more difficult to pump. Many recycled paper and agricultural products have been marketed or tested. Among those marketed are office waste, corrugated boxes (PFM), chopped newspaper, and seed screenings. Also tested by the author were whole and ground rice hulls, ground cereal straw, and washed dairy waste.

The most important quality of a hydromulching material is that it must adhere to the soil even on steep slopes and hold the seed in place during heavy rainfall impact and wind. If it fails in those functions, other characteristics (water-holding capacity, appearance, cost, etc.) are not important.

Hydromulching materials have been tested (by the author) by applying them to the surface of greenhouse flats of 13 x 19 in. filled with decomposed granite. The flats were inclined at 45° (1:1 slope) and subjected to artificial rainfall of 3-mm drops falling 15 feet from a 1-inch grid at 6 in. of water/hr. Virgin wood fibers of aspen and alder offered considerable soil protection and were consistently superior to all other products. The only recycled products to approach their effectiveness were the PFM products made from corrugated boxes. One lot of these fibers had been separated on the basis of length, with the shorter fibers being recycled into other paper products. These longest fibers were at least equal to the virgin wood fibers. Tests of commercial PFM products, however, do not always produce such satisfactory results, apparently because they contain a high proportion of short fibers. Commercial materials made of office waste, newsprint, and seed screenings are vastly inferior. These and other recycled materials wash from the slope with the first raindrops. A satisfactory material could probably be made from

Mulches *from page 17*

recycled material if more attention were paid to fiber length.

Working with Mr. Tom Miles of the Oregon Field Sanitation Committee, we found that a satisfactory hydromulch can be made from fibers of grass or cereal straw. Fibrated straw is manufactured by presteaming chopped straw and refining this through rotating close-tolerance discs and drying. Tests show that the process effectively eliminated the allelopathic (germination-depressing) characteristics of ryegrass straw. Fibrated rice straw also makes a satisfactory hydromulch, more resistant to raindrop impact than fiber made from ryegrass.

Fiber testing has been for characteristics which protect the soil surface and hold the seed in place. However, these same characteristics may hold the seed and prevent them from readily falling into natural depressions in the soil where they can become covered with soil. Under these soil conditions it may be better to use very little fiber, or even no fiber. The unsatisfactory products mentioned above may, under these circumstances, result in a better grass stand than using a quality fiber. The best choice would be to broadcast seed or drill first and then cover with a quality hydromulch.

Another important property of mulch is its moisture-holding characteristics. A standard procedure for measuring this characteristic has been developed by the California Department of Transportation (Hoover 1976). In general, products with the longest fibers and best slope-adhering characteristics also have the highest moisture-holding capacity.

Commercial fibers are usually dyed with a fugitive green dye which lasts only a few hours or days. This visual aid assists in obtaining an even distribution on the slope.

Rates of hydromulch vary from 500 to 3,000 lb/acre. The rate of 500 lb/1,500 gal. water is suggested as necessary to disperse seeds evenly in the slurry, and to protect seed in passing through the centrifugal pumps commonly used in hydraulic seeders (Kay, 1976). This would cover one to three acres, with best coverage on one acre and possible distribution problems if used on three acres. A minimum of 1,000 lb/acre is necessary to hold the seed on a slope. An inconsistent "mulch effect" has been observed with less than 1,500 lb/acre. Currier (1970) expressed some concern that "60-70% of the seed hangs up in the mulch and has little or no chance to get its primary roots into mineral soil." Studies with wood fiber (Kay, 1973) showed that under conditions of adequate moisture, small grass seeds such as Durar hard fescue could emerge through as much as 9,000 lb and readily emerge from between two 1,000-lb layers. Placing the seed on top of 2,000 lb speeded emergence and total ger-

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Summary of methods and costs of common erosion-control practices.

Treatment	Comments	Pregermination erosion effectiveness*	Effectiveness on plant establishment*	Approx. cost per acre $**
1. Seed and fertilizer broadcast on the surface, no soil coverage or mulch.	Inexpensive and fast. Most effective on rough seedbeds with minimum slope and erodability where seed will cover naturally with soil. Suitable for remote or critical areas where machinery cannot be taken.	1	1-4	250
2. Hydroseeding or hydromulching (seed + fertilizer) with 500 lb. wood fiber, 1,500 gal. water/3 acres.	Similar effectiveness to broadcasting seed and fertilizer. Not enough fiber to hold seed in place or produce a mulch effect. Seed distribution would be improved by increased volume of water.	1	1-4	250
3. Seed and fertilizer broadcast and covered with soil (raking or dragging a chain, etc.).	Does not require special equipment. Generally a very effective treatment. Labor cost is high on areas not accessible by equipment.	1	3-4	320
4. Hydromulching with 1,500 lb./acre wood fiber (plus seed and fertilizer).	Most common hydromulch mix in California. Advantages include holding seed and fertilizer in place on steep and smooth slopes where there may not be an alternative method. Only a minimal mulch effect. Cost is much higher than 2.	2	3-5	425-520
5. Hydromulching with 1,500 lb. woodfiber plus an organic glue: Ecology Control, Terra-tack III etc. plus seed and fertilizer.	The addition of an organic glue will sometimes improve fiber holding and germination. Does not increase labor or machinery cost.	2 +	3-6	550-650
6. Hydromulching with 2,000-3,000 lb./acre wood fiber plus seed and fertilizer.	Produces a true mulch effect and some erosion protection. Commonly better results than 1,000 lb. fiber or fiber plus glue.	2-3	4-7	530-750
7. Seed and fertilizer broadcast and covered with soil as in 3 above, but followed with hydromulch of wood fiber at 2,000-3,000 lb./acre.	Very effective, combine advantages of seed coverage and mulching.	2-3	6-8	680-865
All of the above treatments offer only minimal protection from the impact of raindrops and water flowing over the surface, but are all weed free.				
8. Straw or hay broadcast with straw blower on the surface at 3,000 lb./acre and tacked down (asphalt emulsion, Terratack II, etc.). Seed and fertilizer broadcast with hydroseeder or by hand.	Common elsewhere in U.S. Very effective as energy absorber, mulch; and straw forms small dams to hold some soil. May be weedy depending on straw source. Not for cut slopes steeper than 2:1. Cost would increase significantly if slopes over 50 feet from access, or application is uphill.	5-7	8-10	650
9. Straw broadcast 4,000 lb./acre rolled to incorporate (punched) another 4,000 lb. straw broadcast and rolled, seeded and fertilized. Seed and fertilizer broadcast with hydroseeder or by hand.	Common on difficult fill slopes in California. Very effective. Not possible on most cut slopes. Very weedy. Cost would increase significantly if slopes over 50 feet from access.	6-8	8-10	877-1070
10. Roll-out mats (jute, excelsior, etc.). Held in place with wire staples. Seed and fertilize as in 1 or 2.	Some are a good mulch, weed free, adapted to small areas. Can be installed any season, cuts or fills. Unsightly. Difficult to install on rocky soils.	5-7	5-10	2400-2700
11. Polyethylene sheets. (4 mil) Seed and fertilize as in 1 or 2, use clear plastic, black if no seed is used.	Useful for temporary control. Can be installed any season. Unsightly, wind is a problem in installation and maintenance. May be difficult to establish plants.	10	?	2400-2700
12. Seed and fertilizer broadcast, or hydromulched with fiber (treatment 2 or 4), followed by erosion control chemical such as polyvinyl acetate at 6:1 dilution (6 parts water) at 1,000 lb. solid/acre (approx. 200 gal. PVA).	Very expensive, but will hold soil and seed in some very difficult conditions. May restrict penetration of water into soil. Will not cure below 55°F. Not effective on soils which crack. Will not support animal or vehicle traffic.	10+	?	1070-1370

* 1 = minimal, 10 = excellent.

** Assumes seed plus fertilizer $150.00, fiber $150/con. Ecology Control $1.25/lb., PVA $3.00/gal., 1,500 gal. hydroseeder with 2 man crew $55.00/hr., labor $13/hr., straw $50/T, straw mulcher with 4 man crew $64/hr. (applies 2 T/hr.) and markup of 30% for overhead (including equipment depreciation), and profit. Cost figures were derived from conversations with contractors, and by review of recent Caltrans contracts.

From: Kay, B. L. 1976. Hydroseeding, straw, and chemicals for erosion control. Agronomy Progress Report No. 77. Agronomy and Range Science Department, UCO. Mimeo. 14 p. June.

mination of orchardgrass and did not reduce emergence of any of the other five species tested.

Under conditions of limited moisture, created by applying the mulch over seed broadcast on greenhouse flats filled with various problem soils, inclining the flats at slopes of 1:1, 1.5:1, or 2:1 (horizontal to vertical measurement) and exposing them to natural rainfall yielded the data in Table 2. On the steepest slopes (1:1 and 1.5:1), 1,000-2,000 lb of fiber was necessary to hold the seed in place. Without that amount, no seedlings were established. On the flatter 2:1 slope, the 1,000-lb rate did not improve the stand whereas 2,000 lb did. Increasing the rate to 3,000 lb increased the number of seedlings on the most severe test with either decomposed granite or fine sand. In recent tests by the author near Lake Tahoe, California, 4,500 lb resulted in good grass stands, while 3,000 lb produced only a few seedlings, because of excessive frost heaving.

Wood fiber is an essential addition to most hydraulically applied chemicals, including straw tackifiers. Many soil-binding chemicals will not hold seed, fertilizer, or straw to a slope unless wood fiber is included.

Wood Residues

Wood residues (woodchips and bark) can be used effectively if locally available as a waste from the forest-products industry or chipped on the site during land clearance. Smaller wood-residue particles, such as shavings or sawdust, would be subject to wind loss. Woodchips and bark can be applied with a conventional straw-blower to a distance of 18 m. (Emanuel 1971). The rate must be twice that of straw to obtain the same soil protection (Meyer et al., 1972) or even as much as 6 times the straw rate (Swanson et al. 1965). Observations in California indicate that uneven distribution often results in poor or no plant establishment in the heavier (100% ground cover) applications.

Fabric or Mats

Fabric or mats, including jute, exelsior, and woven paper or plastic fibers, are provided in rolls to be fastened to the soil with wire staples. Fiberglass roving (which is blown on with compressed air and tacked with asphalt and emulsion) is also available as a nonbiodegradable substitute. Use of these products is limited by their cost and effectiveness. The rolls require high labor inputs for installation, cost at least four times as much as tacked straw, and are not adapted to fitting to rough surfaces or rocky areas. Erosion from beneath these products is common because they do not have intimate contact with the soil. They must be heavy enough or anchored in enough spots to prevent wind whipping. Several reports indicate they are not as effective as straw (Springfield, 1971). They have the advantage of being weed-free but may be unsightly, a fire hazard, or (in some cases) nonbiodegradable or too rapidly biodegradable to be effective. Dudeck et al. (1970) found excelsior mat or jute to yield the best seedling grass of eleven mulch treatments tested. Swanson et al. (1967) found jute, excelsior, and prairie hay or fiberglass anchored with asphalt emulsion to be the best of all treatments.

Mats would be used only on small areas, such as to repair failures of other treatments, where time and cost factors are of secondary importance. They should be maintained, repairing tears, etc., before wind or water can cause extensive damage.

CHEMICALS

Chemicals to be used as a mulch, humectant (a substance that absorbs or helps another substance retain moisture), or soil binder are usually applied in a water carrier or as part of a hydraulic seeding slurry. They are expensive and very specialized, and must be used correctly for maximum effectiveness. They are not substitutes for sound agricultural or engineering practices, regardless of glowing advertisements. Products are discussed here as either fiber tackifiers (including humectants) to be used as part of a seeding, or plastic emulsions which may be used with a seeding or alone as a soil binder.

Fiber Tackifiers

Fiber tackifiers are generally advertised to hold fiber in place, promote germination, hold moisture, and retard erosion. Most sales literature acknowledges that fiber should be used with the product. Within this group we have tested Ecology Controls M-Binder, Kelgum, Terratack I, Terratack III, Styrene butadiene, Super Slurper, PVA, and Verdylo Super.

Although virgin wood fibers as a hydraulic mulch adhere well to slopes without the addition of glues or tackifiers, interest continues in products which would improve their resistance to wind or rain. Of the variety of products previously tested, only a few improved the fiber characteristics, and then only slightly or inconsistently. Most products do make the slurry easier to pump, allowing the addition of more fiber/load.

Most existing products are sensitive to fertilizer. Adding 16-20-0 ammonium phosphate-sulfate at 500 lb/acre to 1,500 lb of wood fiber greatly reduced the effectiveness of Terratack III (an alginase), Ecology Controls M Binder (husk of *Plantago insularis*), PVA (polyvinyl acetate homopolymers or vinyl acrylic copolymers), Super Slurper, and SBR (styrene butadiene). These and all following tests involved applying treatments to greenhouse flats, inclining the flats at 1:1 after curing, and exposing them to artificial rainfall of 3-mm drops at 6 inches/hour.

Two new products promise to be much more effective than those previously tested. The two products are of very different composition, an improved SBR (styrene butadiene), and Super Slurper, an absorbent polymer made from starch. Several SBR Products are sold for erosion control. The available SBR products differ considerably in pH (acidity) and can therefore be expected to perform quite differently. The product tested in the current studies is XFS 4163-L Dow mulch binder, a liquid which utilizes a dry powder modifying agent (methyl cellulose). Super Slurper, a USDA patent, promises to have many uses. This dry powder is reported to be able to absorb up to 1,000 times its weight in water. The sample tested is SGP absorbent polymer from General Mills.

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Mulches *from page 20*

Applications of Super Slurper or Dow SBR without fertilizer in a slurry with 1,500 lb/acre fiber have shown their superiority to other products. Super Slurper at 100 lb/acre is comparable to SBR at 30 gal/acre, but even one-half these amounts is superior to the old products. Super Slurper will require use of aboutt twice as much water/acre as would normally be used to apply wood fiber at these rates.

Super Slurper in a fiber slurry is much less effective when used with fertilizer. SBR, in contrast, is made only slightly less effective by fertilizer. Previously tested was another SBR product which was seriously affected by fertilizer in that rubber balls were formed when fertilizer was added.

These two products are quite different in the form they take. SBR cures to a crust or film, whereas Super Slurper does not cure, but forms a viscous water-absorbing surface if moisture is present.

Recent tests have shown that applying a quality glue after the hydro-seeding-mulching operation, in the same manner that tackifiers are applied to straw, is many times as effective as including the glue in the hydro-seeding-mulching slurry. Particularly effective was the Dow Mulch Binder XFS 4163-L. Rates as low as 20 gpa with 0.75 lb modifier and 86 lb of wood fiber in 344 gal water as a tackifier over 1,500 lb of fiber with seed and fertilizer gave a surface that was more resistant to rainfall impact than 60 gpa applied in the single slurry or resistant for a much longer period than 20 gal in a single application. Similarly PVA applications were improved by a split application. Super Slurper performance was similar in single or split applications. Plant emergence or growth were not adversely affected by splitting the application of any material. Germination may be reduced and delayed by use of fertilizer with SBR. Using higher rates of seed will compensate for this loss. The low total volume of SBR required will call for careful application.

There is a hazard to the seed in using highly effective mulches or additives. These products or combinations may retain enough moisture to allow germination when the moisture in the soil is too low to permit establishment. Simply covering the seed with soil may be more effective in that the seedbed will remain dry until enough moisture is available for both germination and growth. Where enough moisture for growth is present or can be provided, Super Slurper might help keep the soil surface moist during the germination period.

Soil Binders

Plastic emulsions have been used for about a decade to bind surface soil particles for protection from wind and water erosion. Their use has been limited, however, by relatively high cost and by numerous reports of ineffectiveness and negative effects on plant establishment (Sheldon and Bradshaw 1977). Among the emulsions used are polyvinyl acetate homopolymers or vinyl acrylic copolymers, generally called PVA. Commercial versions are Aerospray 70, Crust 500, Curasol AK, Enviro, MGS, Stickum, Terra Krete, and Soil Bond. Soil Seal, similar in effectiveness, is a copolymer of methacrylates and acrylates. Another chemical group is styrene butadiene (SBR). All are an intimate mixture of high-molecular-weight polymeric particles dispersed in a continuous aqueous phase. They are basic ingredients in paint, glue, and other products.

1. Effectiveness and rate

Plastic emulsions give better initial protection than do other commonly used erosion-control practices. The optimum rate determined by the California Department of Transportation is 1,000 lb/acre of dry solids (about 200 gpa) for the polyvinyl acetates (750-1,100 lb/acre on various soils). Most emulsions are about 9 lb/gal and 55% solids. Recent tests compared PVA with an experimental SBR from Amsco Division, Union Oil Company at rates of 500 and 1,000 lb/acre solids. SBR at 500 lb. was similar in effectiveness to PVA at 1,000 lb.

2. Dilution rate

All products tested to date are sold as a liquid concentrate to mix with water. The amount of water used is critical.

Dilutions of 5:1 to 10:1 PVA are far more effective than higher dilutions. Comparison of water, with 5:1-7:1 optimum, 8:1 and 9:1 satisfactory, and 10:1 less effective. All of the tests were conducted on dry sand. Emulsions were applied to a horizontal surface of 13 x 19 inches and allowed to cure at about 60°F for at least two days. The surface was then inclined at 1:1 (steeper than the natural angle of repose sand). The surface was then exposed to artificial rainfall at 6 inches/hr. 3-mm drops, or 6 inches/hr composed of 2 inches/hr, 2-mm drops, plus 4 inches/hr as a mist. Some treatments survived over 120 inches of the latter type of rainfall.

The optimum dilution rate could be expected to be different with other products, on other soil materials, and with other soil-temperature and moisture conditions. Optimum dilution is far less critical for SBR. Tested were 6:1, 12:1, 24:1, and 36:1 at 500 lb/acre solids. The lower these dilution rates, all equally effective, were superior to the 36:1 dilution.

The poor performances of commercial applications can often be traced to the use of too much water. When the emulsion is applied as a component of hydroseeding, a frequent practice, the water required to carry the wood fiber and other components is often greater than the desired PVA dilution. Hydroseeding machines will normally pump 3-5% fiber by weight. If the contract called for 1,500 lb fiber and 200 gpa PVA the dilution rate would be 30:1 at 3% and 18:1 at 5%. (Both the liquid and solid effect of the PVA as well as the possibility of an easier pumping effect of PVA are ignored in these calculations as a safety factor to avoid a plugged hydroseeder full of expensive components.) This means that the PVA must be applied separately—after the first application (containing the fiber, seed, and fertilizer). A material which is less restrictive as to dilution rates would then be advantageous by allowing a single rather than split application. However, the benefits discussed

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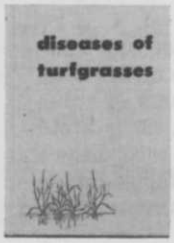

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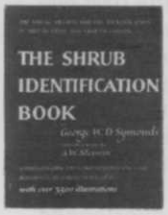

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Mulches *from page 22*

earlier of split applications allowing reduced chemical rates should easily make up for the cost of a second application.

3. Curing of emulsion film

A primary limitation of emulsions is the restriction placed on curing. The minimum curing temperatures generally recommended are 55° F for PVA and 40° F for SBR. Also required are proper drying conditions. Fog will prolong by many days the curing time of either emulsion, and rain before the emulsion is properly cured may prove the crust to be ineffective. A logical use of the materials would be when the construction project halted for the winter. Unfortunately, however, weather conditions which halt construction are the same as those which slow the curing of emulsions.

4. Effect on plants

Plastic emulsions are not generally toxic to plants even if sprayed directly on them. They commonly reduce establishment, however, and delay emergence of grass seedlings. Grass seedlings may have a tip burn. These problems are apparently the effect of fertilizer used with the emulsion and seed, rather than the emulsion itself, and are particularly a problem on sandy soils, and not on clay soils. Fertilizing separately, after seeds have germinated, has avoided the problem of fertilizer burn.

The most practical way so far of offsetting reduced seedling numbers has been to increase the seeding rate. Doubling the rate of Blando brome from 50 lb to 100 lb/acre has generally compensated for plant losses due to fertilizer, and sometimes resulted in an increase in numbers, ground cover, and pounds of grass growth. Wood fiber is an essential part of an emulsion treatment, particularly if seeds are used. PVA emulsions will not stick seed or fertilizer to a soil slope. Unless a fiber is added the seed and fertilizer will wash off readily. Do not apply fiber and seed after the emulsion, for they will wash off.

5. Other considerations

Freezing temperatures destroy all uncured emulsions. Biological activity also may limit the storage life of emulsions. Crusts formed by emulsions may shed most of the rainfall. Therefore they may limit plant establishment and growth in low rainfall areas and soils of low water-holding capacity. Crusts are not self-healing. The treated area must be protected from vehicles and animals, and breaks should be repaired. Crusts will not survive frost heaving. The emulsion could be used very effectively with transplanted shrubs. A soil-active herbicide could be used with them to provide a weed-free erosion control program.

SOIL AND ROCK MULCHES

Soil and rock mulches are often overlooked as the most practical solution to plant establishment and soil protection problems. The microsites created by rough seedbeds or rock provide seed coverage, separation of seed and fertilizer, and a mulch effect.

The importance of microsites to the establishment of plants was illustrated by Evans and Young (1972). In their Nevada study, seedling emergence and the growth of downy brome, medusahead, and tumblemustard were favored by seed burial, pitting of the soil surface, and soil movement. Air temperatures were continuously measured at the soil surface and 3 cm. above, and soil moisture from the surface to 1 cm. deep, and at 3 cm. Results showed that depressed sites retain moisture longer at the surface and have more favorable atmospheric moisture and temperature regimes than the flat soil surface. Conditions are also created for more adequate soil coverage of the seeds, which in turn further modified their environment.

A practical approach on steep slopes, such as highway cuts, is the use of benches, serrations, or simply rough grading. The rough effect can often be achieved by simply eliminating the final grading operation. Special pitting equipment is available for nearly-level sites. "Track walking" (walking a tractor on a slope to create cleat marks) is widespread and very effective.

Mulches of crushed stone or gravel one inch deep provided more effective erosion control than 4,000 lb/acre of straw, and heavier rates of stone were even more effective (Meyer et al., 1972). Field observations in Nevada and California also show a ground-cover of gravel to be effective for reducing wind and water erosion and encouraging invasion by indigenous plant species.

RELATIVE EFFECTIVENESS AND ECONOMICS

Mulching practices vary considerably in cost and effectiveness. Sometimes the characteristics of the site to be stabilized determine the only practical treatment. Usually, however, there are alternative methods which should be considered.

Seed coverage and mulch should be the first consideration. Seed germination and plant establishment will be improved more by seed coverage than by any other treatment. Mulch treatments increase in effectiveness with both the amount of mulch per acre and the length of the fiber. While it is possible to apply excessive amounts of mulch, economic considerations usually prevent it. The importance of fiber length, however, should not be overlooked. Increasing the fiber length (as from wood cellulose fiber to straw) may greatly increase the effectiveness of erosion control and germination (Kill et al., 1971; Perry et al., 1975). This relatively large increase in effectiveness can be achieved at little or no increase in cost. Even increasing the length of wood-cellulose fiber from a recycled paper product to virgin wood fiber improves results with little effect on cost. Table on page 19 (adapted from Kay, 1976) compares relative effectiveness and costs as observed on roadside erosion-control projects in California. Ranges of cost figures are based on conversations with contractors and review of California Department of Transportation contract bids (all bids, not just low bids) for the 1973-1975 period. Labor costs are at union scale.

The most expensive practice is not necessarily the most effective. For example, straw plus a tackifier is more effective for both erosion control and plant establishment than many of the more expensive treatments. A rough seedbed or covering the seed may be the cheapest and most effective treatment for establishing vegetation. **WTT**

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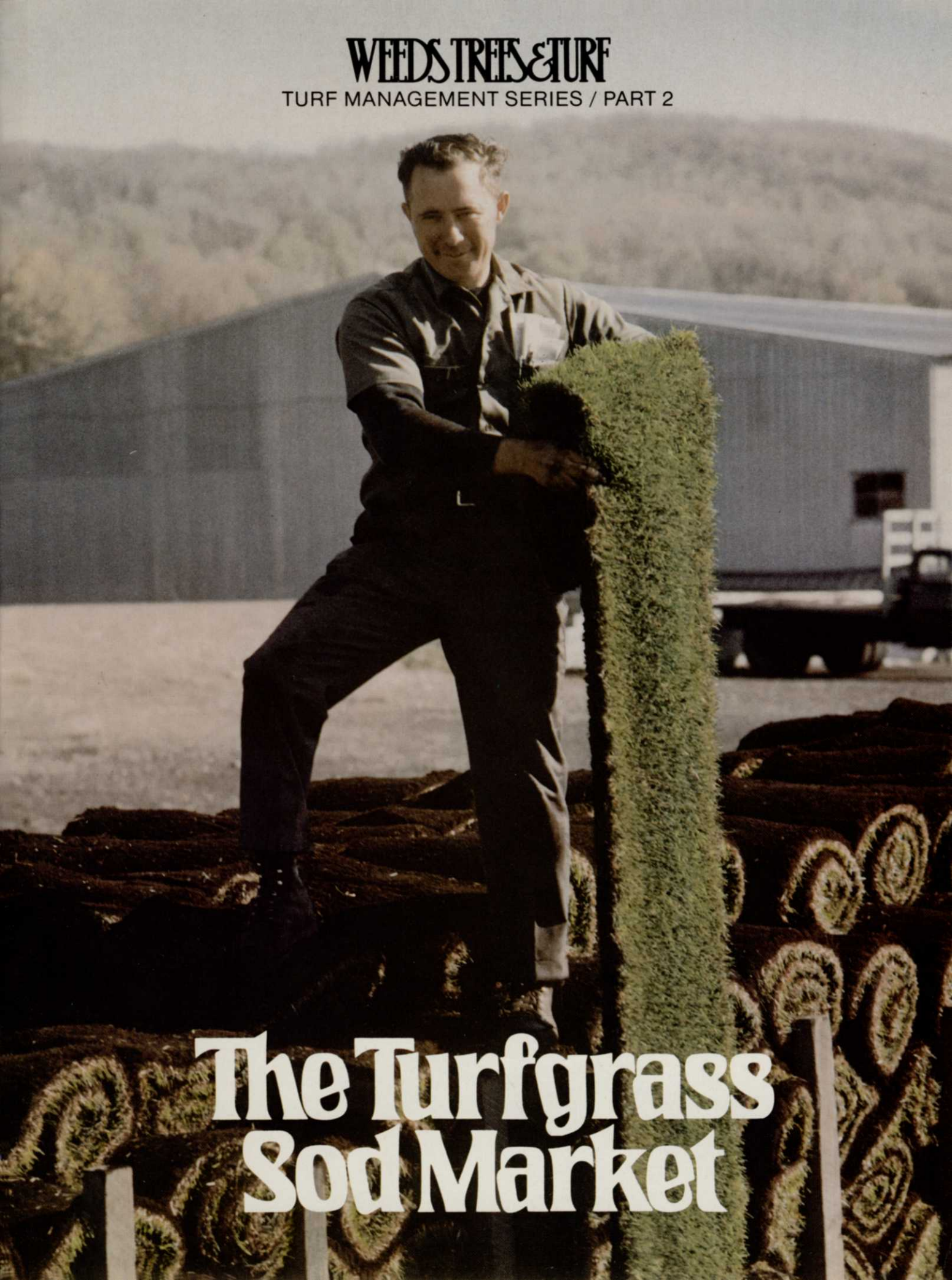
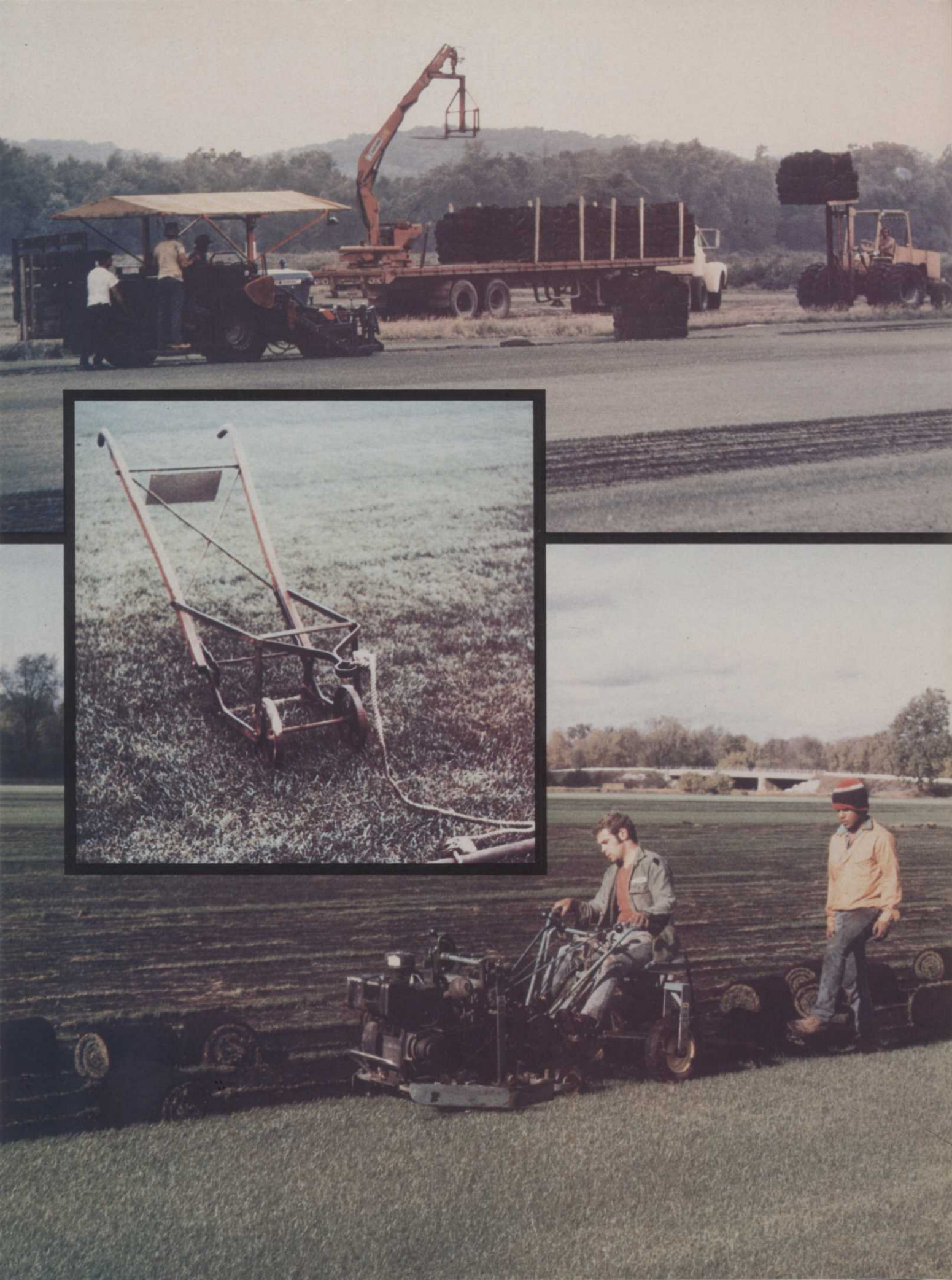


The Turfgrass Sod Market



THE FORMATIVE YEARS

The cultivated sod industry, like the seed industry, began as a mechanism to transplant natural stands of common bluegrass from their rural location to the urban environment. Tied closely to the construction industry, both industries grew as man left the farm to take part in the American industrial revolution.

The original sod producer was really a landscape contractor who would pay farmers in the neighborhood of $100 per acre to cut and remove the pasture sod from their fields. If a job called for instant grass, the contractor would go looking for the fields and the men required. Equipment was primitive and the work required many men to accomplish.

By the 20's, a few cities could support a firm devoted mainly to obtaining and delivering sod to contractors. Unfortunately, few of these companies still exist today. The Depression delayed the progress of the sod industry during the early 30's. By the end of the 30's the market had begun to recover. The concept of planting fields specifically for sod use had taken hold, although pasture sod production still takes place today, mainly for specific jobs requiring native grasses or very low quality sod.

According to Ben Warren of Warren Turf Nurseries in Palos Park, IL, the sod business was one of few healthy and promising businesses in the late 30's when he started. Warren had worked for his uncle as a landscape contractor for nearly ten years and wanted to step out on his own. He surveyed various markets for potential and noticed that two sod companies in the Chicago area were doing very well. In 1938, Warren founded his business, and has since led the way for other sod growers in the U.S., at least in cool season turfgrass sod production.

Ben Warren

Organizer of both Midwest Sod Growers Association and the American Sod Producers Association. Warren is a pioneer in improved turfgrasses for sod and owner of sod nurseries in five states totalling 4,500 acres.

Warren later used vegetative production techniques for much of his bluegrass sod. Vegetative production's history parallels cool season sod production. Early production of bentgrass and bermudagrass stolons dates back to the 20's. Large nurseries of bermudagrass began in Florida at that time and that state developed the first certification program for vegetative parent material, not sod. Southern Turf Nurseries in Tifton, Georgia and Cal Turf in Ventura, California were leaders in mechanization and development of vegetative sod production. See sidebar for more information.

The transition from pasture sod to cultivated sod is still taking place in Europe. A small amount of pasture sod is still used in the U.S. Eastern sod specialists have four categories for sod. The first is cultivated sod which is produced from seed or stolons, carefully managed for weed control, harvested and sold as high quality turf. The second is semi-cultivated sod which is obtained from pastures seeded for the purpose of sod harvesting. Improved pasture sod is third. This sod comes from natural stands which are fertilized and harvested. Finally, there is unimproved pasture sod. The only management of this sod is mowing prior to harvesting.

The quality improved with each type of sod. The sod producer gained control over his product through improved turfgrasses, mechanization, chemicals, irrigation, and advances in the science of management.

In the mid-40's, Ryan developed the sod cutter. This engine powered oscillating knife enabled sod producers to harvest faster and improved the consistency of their product. Considerable labor was still required to roll and load the sod. In 1954, Ryan added a devise to cut the sod into sections and in the 60's an implement to roll the sod as it was cut. Despite this early progress, ways to cut manpower did not develop until the mid 60's.

Merion Kentucky bluegrass made a tremendous impact on the sod industry as it did on the seed industry. Pasture sod harvested and planted one fall on a job site, would be nearly all crabgrass the next fall. Disease just wiped out the common bluegrass during the summer, Fred Grau, former turf specialist at Pennsylvania State University and director of the USGA Green Section, said. Merion provided the disease resistance to withstand summer stress, quick establishment in sod fields, and a more attractive sodded lawn.

Slow release fertilizers were first developed in the late 40's. The

ability to reduce burn potential, supply a steady stream of nutrients to the sod, and speed up grass growth gave sod producers new control over their product. Combined with the release of Merion in 1950, the sod cutter, slow-release fertilizer gave new substance to the business of growing sod. Many of the large sod producers today got started in the 50's. However, they started with comparatively small acreages and took advantage of Merion and eventual equipment improvement to break the 1,000 acre mark. Those who did not respond to improved turfgrass are not around to tell about it.

Those who did take advantage of Merion, like William Ruthven of Canada, were able to ship hundreds of miles into markets where Merion was not available. He shipped sod as far away as Chicago and Washington, D.C. Canada still figures well in sod today with the largest single farm in North America, Gem Sod Farms in Edmonton, Alberta, and Brouwer, the largest supplier of sod harvesters and also a large sod grower in Keswick, Ontario. Today, transportation costs and inspections make export of Canadian sod less attractive on a competitive basis with U.S. sod.

During the late 40's and early 50's, sod producers gained the assistance of selective herbicides and irrigation in producing a good crop in a reasonable period of time, usually 12 to 18 months.

Wiley Miner

Leader of sod industry in New Jersey and developer of one of the first effective sod harvesters.

After Merion was introduced, it was often grown as a monstand. The blend and mixture of turfgrass varieties did not come until the late 60's.

The 60's showed the sod industry as a viable and creative group. The sod grower began the decade as an independent using his ingenuity to solve equipment and marketing problems. He ended the decade organized, with improved equipment, and responsive to changes in turfgrass technology.

Many sod growers tried to solve the material handling problems of sod. They include: Wiley Miner of Princeton Turf Nursery of Hightstown, NJ, and Woodrow Wilson of Eastside Nursery of Canal Winchester, OH, who developed the Princeton harvester; Gerry Brouwer of Keswick, Ontario, Canada who developed the Brouwer harvester; John Nunes of Nunes Manufacturing of Patterson, CA who developed the Nunes harvestor; Martin Beck Sr. of Beck Turf Nurseries in Auburn, AL, who developed Beck's Big Roll harvester; and others who put time, energy and money into solving the equipment problem, such as Ben Warren; William Daymon of Michigan with his sod roller; Ray Jensen of Southern Turf Nurseries of Tifton, GA, with his zoysia plugger and stolonizer; and Toby Grether of Cal Turf Nurseries in California with his fork lift and net layer. In fact, today out of the five major makers of sod cutting and harvesting equipment, four are sod producers as well as equipment manufacturers.

From the standpoint of sod organizations, the Midwest Sod Growers Association was the earliest in the mid-50's. Consisting of sod producers from Illinois, Wisconsin, Michigan and Indiana, the Illinois group organized to correct through lobbying highway sod standards in 1957. The group was fighting specifications for 3-inch thick sod for highways. They knew that thinner sod actually took root more quickly than thick sod.

Common bluegrass pasture sod *near Washington D.C. in the 40's. Photo courtesy F.V. Grau.*

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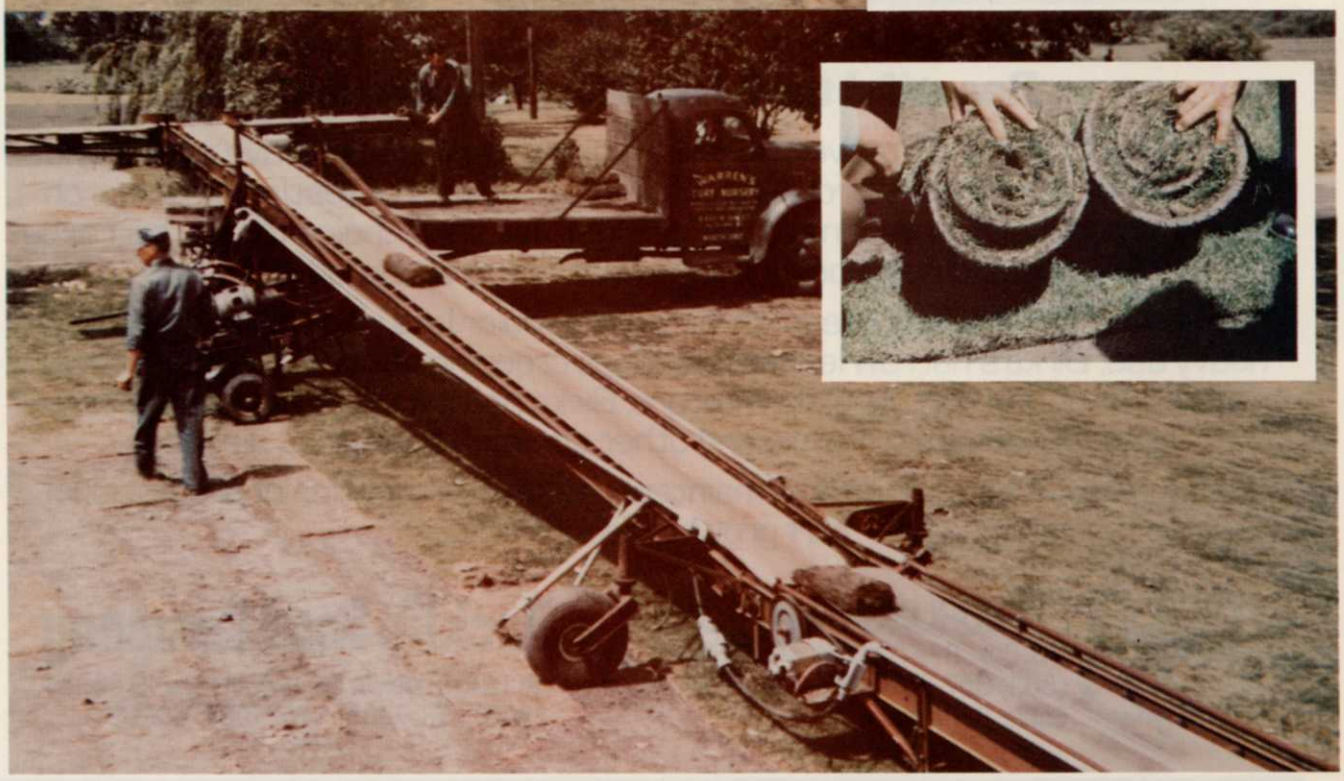
They also knew the weight problem of thick sod and the likelihood of sliding down embankments. They won their case and continued to serve as a force in sod production until the formation of the American Sod Producers Association.

Another early organization was the New Jersey Cultivated Sod Growers Association, formed in 1964 with the leadership of Wiley Miner and Dr. Henry Indyk of Rutgers. This group supported the development of a sod certification program for New Jersey. The mid-60's were very exciting years for New Jersey sod growers with the creation of an organization, the development of certification and the first demonstrations of a sod harvester prototype designed by Miner at the New Jersey summer field days in 1966.

During the 60's a group of five sod producers and a number of turf specialists began meeting at the Golf Course Superintendents Association of America Show. They included Ben Warren, Tobey Grether, Wiley Miner, Gene Johanningsmeir of Michigan, and Jim Ousley of Florida. Meeting with them were turf specialists Dr. Henry Indyk of Rutgers, Dr. William Daniel of Purdue, Don Juchartz of Michigan State University, and Dr. Elwyn Deal of the University of Maryland. Finally in 1967, at the GCSAA Show in Washington, D.C., Warren made the motion to create a national association and Miner seconded it. The industry finally had its own voice. Growing slowly at first, the organization has had three executive directors in its history. First was George Hammond of Paint Valley Bluegrass in Columbus, OH; second was Indyk from 1969 to 1973; and third Bob Garey from 1973. In 1973 American Sod Producers Association began holding a winter meeting as well as a summer field day. Today, ASPA has nearly half of the sod producers of the U.S. as members and supports research at various universities across the country.

Those states that have sod certification started it in the 60's. New Jersey established the first certification program which was followed by Maryland and Virginia. Basically, certification consists of inspection of fields prior to planting, approval of the seed blend or mixture, and periodic inspections during pro-



Early vacuum *at Warren's Turf Nursery in 1956. (left) Sod cut at 1/2 and 1 inch (below). Loading truck from field showing manpower requirements of sod cutting below). Photos by F. V. Grau.*

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duction. The state publishes a list of approved certified seed lots for sod growers seeking certification. Preplant inspections are meant to find grassy weed problems such as yellow nutsedge. A serious problem with such weeds will exclude the field from certification unless it is fumigated for total weed control.

Seed inspection is intended to find those lots of seed which have no bentgrass of *Poa annua*. It is possible to purchase certified seed with the minimum allowable percentage of *Poa annua* or bentgrass. Some lots harvested from exceptionally clean fields may have virtually no bent or *Poa annua*. It is lots from these fields that inspectors are looking for to recommend to sod growers. Indyk believes that if certification accomplishes nothing else, it gets seed growers to direct their best seed to sod producers in states with certification programs.

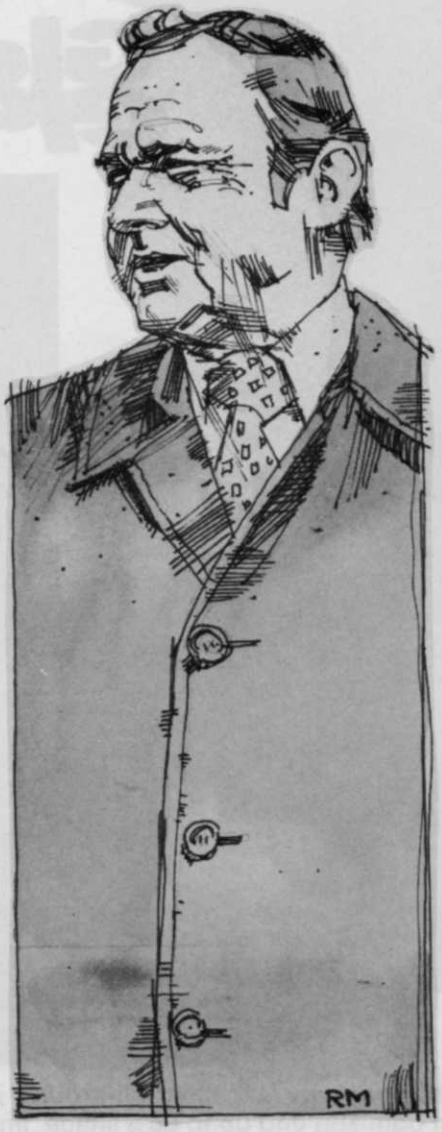
Of course, not all sod produced in these states is certified. As little as 10 percent of the acreage may be certified sod. But when landscape architects who support certification specify certified sod, only that ten percent of the acreage is elligible.

One unique and pressing problem today with certification is that suppliers of sod to New Jersey whose farms are in New York want to grow and meet certified sod requirements. New Jersey says these growers are out of jurisdiction and therefore cannot meet New Jersey certified sod requirements.

Florida had a certification program for vegetative parent material before New Jersey's sod certification program, according to Indyk. Other states considering programs are California and Nebraska. Pennsylvania has a program underway.

Some midwestern sod producers feel certification is unnecessary and slows down progress with new turfgrass varieties. According to these growers competition keeps everyone on their toes. Dr. Jack Butler of Colorado State University in Colorado Springs feels this way. He helped sod producers in Illinois as director of that state's turf program during the 60's. Ben Warren and Dr. William Daniel of Purdue also feel this way.

Certification is also a marketing tool. It is intended to eliminate doubts of those afraid of sod quality. Confidence in sod varies across the country. Architects and contractors strongly recommend sod in some areas, such as Illinois, California, Colorado, and many eastern states. Sod producers continue to work for other ways to strengthen the position of sod compared to seeding. One way is to gain legislation which requires grass cover prior to release of bonding and issuance of occupancy permits. Contractors may not be willing to wait 60 days for seed to germinate and establish an acceptably thick turf. They are liable often for six months or more. The extra cost of sod must be sold to the customer. In the Midwest, seeding costs approximately 6 - 8 cents per square foot as compared to sod at that figure wholesale plus the cost of installation. Retail sod is priced in the area of 15 cents per square foot in Ohio.



Henry Indyk

Rutgers University turf expert who helped organize New Jersey and American Sod Producer Associations.

The instant lawn concept has been pushed for years. Although there are many questions and doubts about improved perennial ryegrasses and tall fescues, they may provide some challenge in certain areas. Establishment time is cut to about four weeks with these turfgrasses when seeded. Basically, it is a question of what is acceptable turf cover for job completion.

The 70's saw the sod harvester take over the sod industry. The Brouwer, Nunes and Princeton harvesters are now found on nearly every sod farm. The harvester drastically cut manpower requirements in harvesting sod. Whereas harvesting with a sod cutter may require up to ten men to accomplish, harvesters cut this number to three in many cases.

The harvester cuts and lifts the sod onto a conveyer. Depending upon the model, harvesters can cut rolls, slabs or folds of sod. After the harvester has rolled or folded the sod, a person on the back of the machine places the sod onto a pallet. When the pallet is filled, the harvester puts it down for pick up by a forklift, and continues cutting. The need to pick up individual rolls of sod from the field is eliminated. The cutting speed of harvesters is faster than sod cutters as well.

The harvester allowed sod producers to handle more acreage with fewer employees. Other improvements to harvesters will further speed up production and reduce waste. These changes however, come at a price. Harvester manufacturers have to prove the cost/benefit of more expensive machinery.

The sod cutter is by no means extinct. Ryan and Turfco of Minneapolis manufacture sod cutters for smaller acreages and for situations where portability is important, such as the remaining pasture sod market. Many cemeteries, golf courses, and parks have sod nurseries for replacement of damaged turf areas. A number of firms making sod cutters and harvesters have stopped doing so. Ryan manufactured the Brouwer harvester in the late 60's. Names like Daymon, Big Brute, Sod Winder, Big J, Gieringer, and Hadfield are now history.

Other progress has helped the sod producer. The improved turfgrasses reduce losses to disease, netting reduces the dependency on sod knitting and shortens production time when needed, and better field drainage gives the sod farmer better

William Daniel
Purdue University turf professor who provided early support to the Midwestern, Michigan and American Sod Producer Association.

Princeton and Beck's Turf Nurseries have experimented with the width and length of the roll for speeding up harvesting and laying. Princeton offers a 20-inch width on some of its harvesters and Woodrow Wilson claims a 48-inch length is the longest that one man can lay in one motion. As for width, Wilson claims the 20-inch width reduces trimming since it fits standard dimensions of tree lawns and other turf areas better than 16- or 18-inch widths.

Beck's offers a sod handling system which includes a harvester that cuts three 18-inch wide rolls simultaneously and a forklift, modified, like those that move rolls of carpet, to transport the sod from the harvester to the truck and from the truck onto the job site. The lengths of the rolls can be set according to the measurements of the job. The system is only available on a franchise basis.

Advanced models of current harvesters further reduce manpower and material handling needs. The new Brouwer harvester has automatic steering which either eliminates strips between rows or standardizes them for vegetative regrowth. The large Princeton, costing more than $100,000 is a combine-like harvester which reloads pallets as one is filled and lowered, has a closed cab, and the additional horsepower of machines that size.

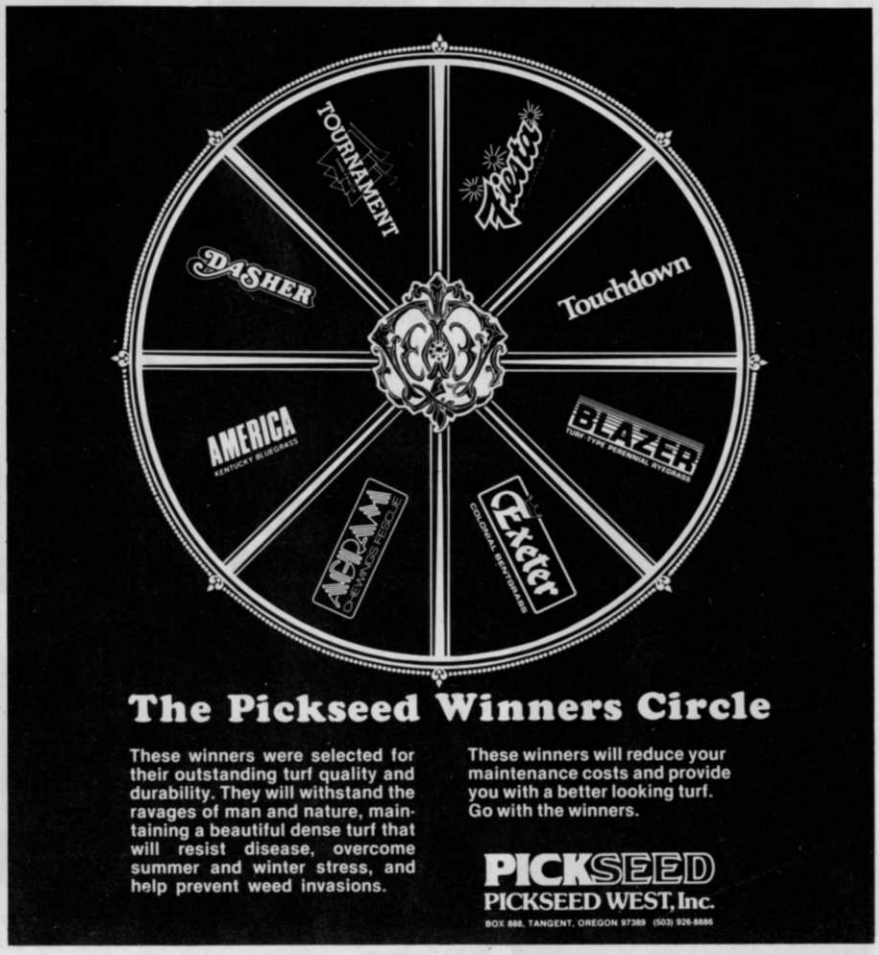
Equipment for net setting, leveling the seedbed, moving pallets, and unloading at the job site have all added to the mechanization of the sod industry.

Warm season operation has had its share of inventors too. Stolonizers, pluggers, planters and other means of handling vegetatively grown sod and stolons were invented simultaneously with cool season machinery by major southern sod producers such as Southern Turf Nurseries and Cal Turf. Ray Jensen and Toby Grether developed various pieces of equipment for southern sod production.

control over weather. Sod production is now a fairly precise operation with considerable control by the grower. If needed, he can push a crop of sod to be harvested six to eight months after seeding. For this purpose some sod producers keep a portion of their acreage netted and well irrigated. They can also utilize more aggressive Kentucky bluegrass cultivars to speed up the sod, or increase fertilization.

Eastside Turf Nursery grows blends of bluegrass to give the sod the potential to adjust to varying levels of maintenance following installation. Certification officials in New Jersey, Maryland and Virginia encourage such thinking. Shade tolerant bluegrasses and creeping red fescues are often added to provide a hedge against installation in shady areas. Some sod growers provide customers with educational pamphlets on sod care to assure proper maintenance of the sod. ASPA provides such pamphlets to members.

The future holds further developments for sod, especially in the areas of harvesting and installation. Installation remains the labor intensive portion of sod use. "The amount of sod sold could double if a method to lay the sod by machinery could be found," says Dr. Daniel. The device would have to be easily portable, reliable, and maneuverable on site. It should lay the sod faster than it was harvested.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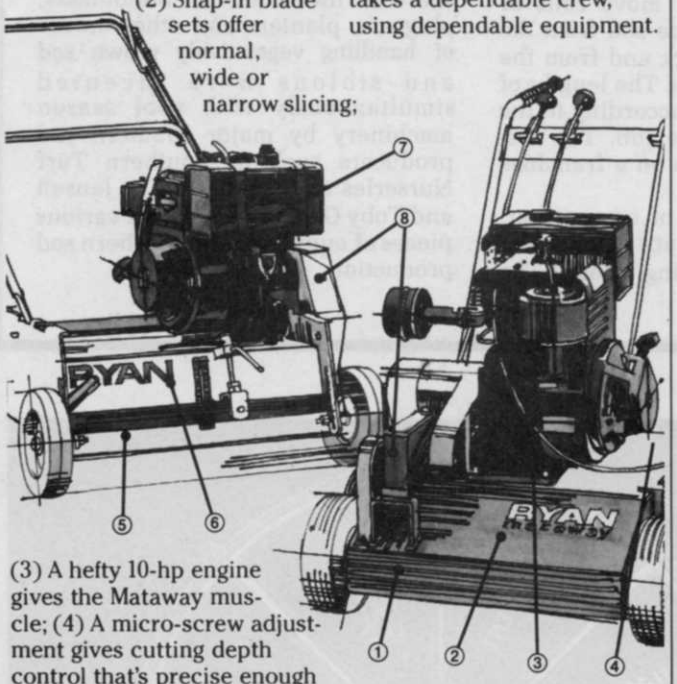

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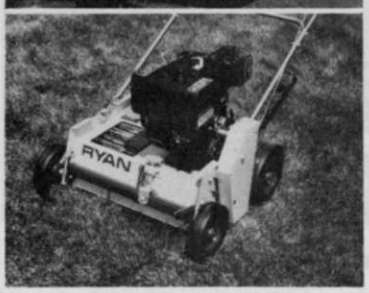

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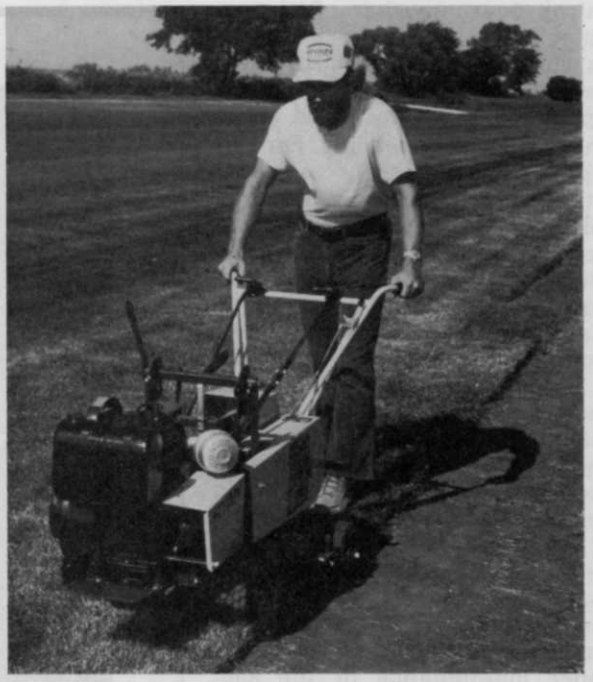
Art Ryan designed the sod cutter produced originally by K & N Machine Works of St. Paul, MN. In 1950, K & N offerred an 18-inch version, a step up from the original 12-inch model. The Ryan Junior sod cutter was designed in 1956. In 1963, K & N changed its corporate name to Ryan Turf Equipment Co.. Within the next five years, Ryan introduced the sod roller (1965) and the sulky roller (1968).

The Ryan corporate policy is "whenever improvements are made on any product, the improvement is designed so that it can also be adapted to the present machines in the field."



Heavy duty sod cutter *(top) is an improved version of a 1947 model. Sod cutter with sulky roller (bottom) still meets the needs of many sod producers.*

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Cool Season Production

From two nuclei, Illinois and New Jersey, cultivation of cool season sod production spread in the 60's. Michigan, Indiana, Minnesota, Wisconsin, and Ohio sod industries grew in number of firms and competitiveness. The midwestern boom spread westward to Missouri, Kansas, Colorado, Nebraska and California in the late 60's.

From New Jersey, growth spread quickly to Maryland, Virginia and Pennsylvania and northward to New York and Connecticut. By the early 70's, cool season cultivated sod production was clearly established and busy providing the needs of a boom in housing and industrial building. Competitiveness kept prices down forcing growers to work toward volume for profit. Mechanization clearly separated the men from the boys and later helped stabilize the market to its current position.

Like the stripping crews in seed production, the pasture sod business faded as newer technology took over. Sod nurseries grew in size and began offering a variety of turfgrasses. Seed companies and extension turf specialists saw the potential of the market and began providing special attention to sod production. Michigan, under pressure from the Sod Growers of Michigan and the Michigan Turfgrass Foundation, legislated a special turf fund for research. Turf specialists now had at least part of their work time designated for sod production service. Sod was a separate power from golf but served to supplement the turf cause in turf research from a public funding standpoint. Older research programs such as Pennsylvania, Ohio, New Jersey, Virginia, Maryland, Michigan, Illinois, and Nebraska found new support and grew as a result. The second generation turf researcher was studying during a boom period for turf. Some of them moved from older institutions to newer programs such as California, Colorado, Oklahoma and Texas and broadened turf research there.

It was the sod producer that really spread the word about improved turfgrasses. The obvious difference of a lawn sodded with an improved turfgrass next to one sodded or

Ben Warren and assistant *in turf greenhouse evaluating turfgrass selections.*

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PROFILE

Pine Island Turf Nursery

The sod industry grew rapidly in the 60's. An example of a firm who entered the business in the mid-60's is Charles Lain, owner of Pine Island Turf Nursery in New York.

Lain left his job with Weyerhaeuser in 1964 and started a sod nursery in 1964. In 1966, he stepped out on his own. He served as president of the American Sod Producers Association in 1979 and today manages a 435 acre business with sales of more than $500,000.

Lain's nursery is located in New York's largest sod growing region. The area has more than 3,000 acres of sod production on its black, mucky soil. Lain competes with Warren's Turf Nursery in the same area and other growers serving the New York City area including DeLalio and McGovern sod farms in Long Island.

The Pine Island area is among the richest in terms of soil fertility in the country, with vast onion, lettuce and celery production. The soil is acidic and contains a fair amount of aluminum and iron. "Chemicals that work on upland soil don't always work on muck soils," says Lain. In the fall, he applies 600 lbs/acre of 10-30-20 and three tons of lime per acre. He feeds again in late October with 300 lbs. of 20-5-5 and finally the next spring with 350 lbs./acre of 45 percent urea. Based on soil tests, he adds copper and adjusts the phosphate. He supplements the area's 25 inches of rainfall with irrigation.

Lain used Ryan sod cutters until 1974 when he bought his first Brouwer harvester. "The harvester has allowed us to get more production per acre by reducing loss between five and ten percent," says Lain. "It also allows us to harvest more tender, younger sod."

"It used to take 12 workers six hours to harvest one acre of sod using the sod cutter. Today, we harvest an acre in less than four hours with three to four workers," Lain boasts. The harvester enabled Lain to reduce peak season labor by eight persons.

Lain grows a blend of Adelphi, and two of three other improved Kentucky bluegrasses, Touchdown, Majestic and Glade. For shady areas, Lain sells a mixture of Warren's A-34, Glade, and Fortress and Jamestown fescues.

"Sod is plagued much more by weeds than disease," says Lain. After harvesting he applies Roundup to eliminate weeds such as Quackgrass. Crabgrass, foxtail, barnyardgrass, and other weeds are controlled by spring and fall applications of Banvel-D and 2-4,D and two applications of D.S.M.A.

In 1977, Lain lost nearly a third of his mature sod to leaf spot after a very wet spring. Lain indicated fungicide treatments are not required as often in his area as in others.

Marketing is a firm commitment to Lain. He spends nearly ten percent of his sales on billboards, newspaper advertising, brochures and radio messages. Sales have increased by nearly 20 percent per year since 1976. Eighty percent of his sales are to landscape contractors, 15 percent to garden centers, and five percent retail. He often provides retail customers with maintenance information to help assure the sod of proper care and Lain of a satisfied customer. *Story and interview by Carol Rose.*

seeded with common Kentucky bluegrass made the public take notice of improved turfgrasses. The demand upon garden centers and landscape contractors for improved turfgrasses grew. Landscape architects starting specifying the improved Kentucky bluegrasses.

Today, the number of new turfgrass cultivars is clouding the issue of what type of sod to produce. Sod producers must anticipate demand 18 months ahead of time. They know they have good demand for certain solid performers. Their willingness to devote much acreage to a steady stream of improved grasses is limited to the sales advantage of switching from one to another. So, their acceptance is slow

Gerry Brouwer
Ontario sod producer and equipment maker who helped spur the industry on with his side tracking sod harvester.

and cautious. Each time they add a new turfgrass they also accept the need to educate customers of the advantage of it. The fact that landscape contractors and architects are better voiced on improved turfgrasses does speed up the educational process. Therefore, seed growers have a larger educational job to do.

The number of sod producers has stabilized in the last five years. Acreages increase to meet rising demand. The market appears just as solid as Ben Warren found it in the late 30's, and some conglomerates are acquiring sod nurseries. Two examples are Cal Turf's acqisition by American Garden Products and its takeover by Amfac of Honolulu, a large agribusiness corporation, and the purchase of Southern Turf Nur-

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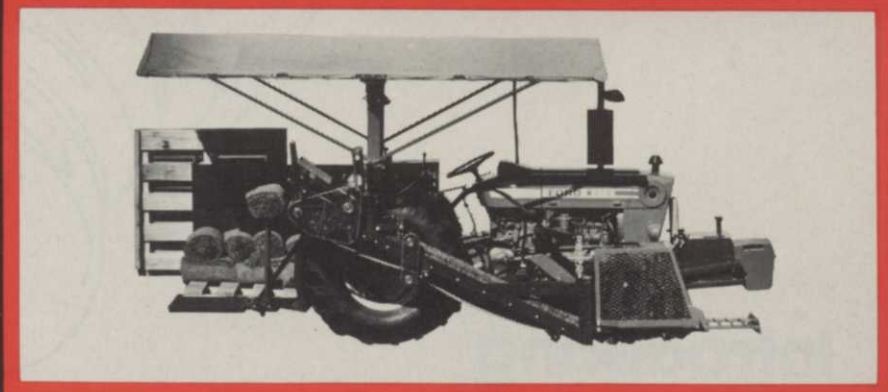

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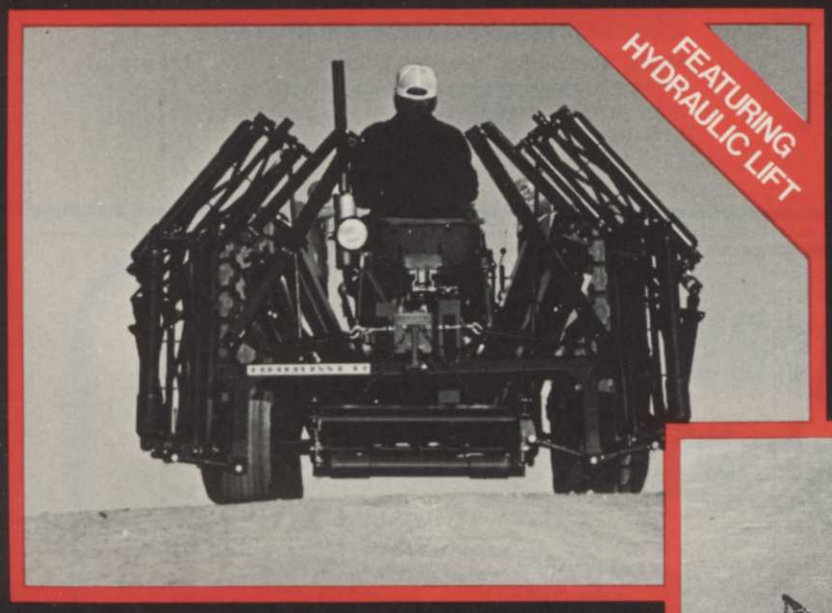

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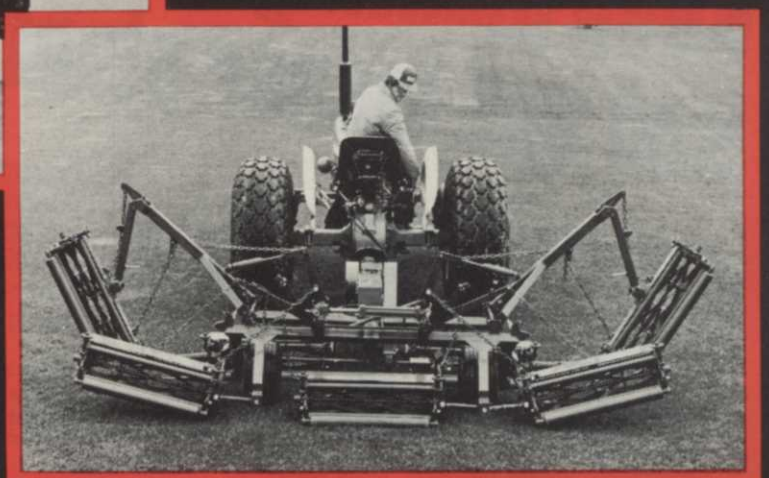

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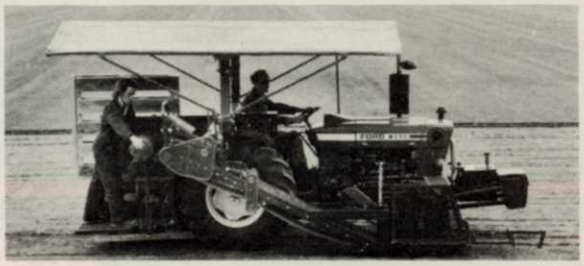
Brouwer Turf Equipment Ltd.

The largest manufacturer of sod harvesters is the Canadian company Brouwer Turf Equipment Limited. A sod producer himself since the mid-60's, Gerry Brouwer began production of the Model A harvester in 1972. Brouwer still farms 1,500 acres of sod in addition to his rapidly expanding equipment business. The unit is designed to either roll, slab or fold and operates off the uncut turf which prevents tracks and turf damage. Brouwer recently announced production of a new line of harvesters, the Model 2000. This unit offers innovative features such as automatic steering, automatic empty pallet loading and four-wall stacking area. It can harvest 2,000 sq. yds. per hour with minimal waste.

Brouwer also makes the light weight Hitch-Hiker fork lift, a side-unloading grass collector, a turf roller, and PTO gang mowers. The company recently established a sales office in Europe to meet sales and service demands of overseas sod producers.



Model 2000 *is the newest Brouwer harvester featuring automatic steering and empty pallet loading (top). Model A harvester is used by more sod producers than any other harvester.*

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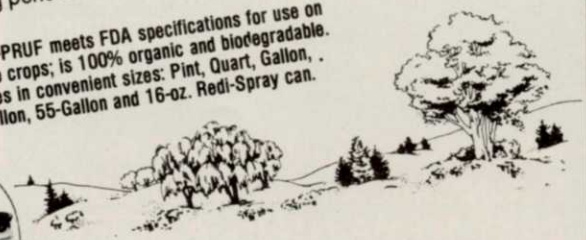

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Dr. A. J. Turgeon and co-workers J. E. Haley and J. R. Street conducted intensive Kentucky bluegrass cultivar management studies.

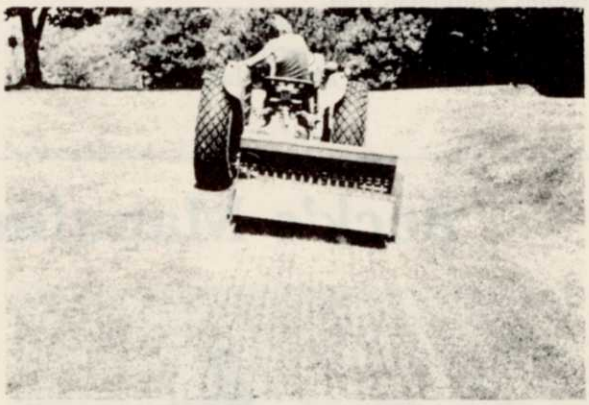
Twenty-one cultivars were planted in September 74. Varying management regimes were imposed to measure their competitiveness against the infestation of Poa annua.

They concluded: *"The most impressive differences among cultivars were observed under close mowing (0.75") and high fertilization (8 lb./N per 1000 sq. ft.). Several of the cultivars were virtually overrun by Annual bluegrass while others remained nearly weed free. Those cultivars which are apparently best adapted to this cultural intensity include A34, Brunswick and Touchdown".*

Touchdown fights Poa annua two ways:

First — its superior disease resistance means it won't thin out from Crown rot (Leaf spot) Leaf rust, Stripe smut or today's Fusarium so Poa can't get a foothold . . . and secondly it's so aggressive and dense in growth habit it just keeps on fighting Poa.

Touchdown is ideal for overseeding . . . it germinates fast and quickly develops a healthy, mature turf.



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EQUIPMENT

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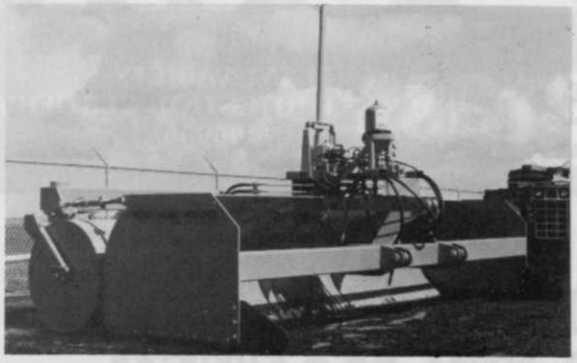

Laser scraper

Rotary mower

The two largest forces in sod in California are Nunes and Cal Turf, now part of American Garden Products, recently acquired by Amfac. The two people behind the firms are Tobey Grether of Cal Turf and John Nunes of Nunes Turfgrass Nurseries. Grether sold his interest in the 70's. But John Nunes and his son Greg manage 1,500 acres of sod, orchards, and diversified row crops, as well as Nunes equipment line.

Nunes manufacturers a line of sod equipment including a harvester, vacuum sweeper, rotary mower, sod netter and a laser land leveler. Although distribution of its Kentucky bluegrass and bermudagrass sod is regional, its distribution of equipment is international. The company is headquartered in Patterson, 90 miles east of San Francisco.

Nunes also has "Instant Grass Centers" in nine California cities to market its sod and other landscape materials. This marketing effort certainly gets the idea of sod across to potential customers. It may be one of the reasons sod is so well accepted in California.

Beck's Manufacturing Company

Big Roll Harvester

Sprig Planter

A unique answer to the sod harvesting and handling situation is Beck's Big Roll. This system harvests three 16-inch rolls of sod simultaneously and can lay them the same way. The sod is rolled onto cores which are handled by a carpet pole like device. This core permits handling by cranes and adapted forklifts. It also permits laying with a tractor three rolls at a time.

Beck Manufacturing Company is a division of Beck's Turf Nursery, one of the earliest producers of zoysiagrass in the country. Another product of Beck's is Lawn-O-Matic sprigger which sprigs or plugs three 8-inch rows at once.

The Big Roll system is available on a franchise basis only. This guarantees a territory for the franchisee. The Beck Manufacturing Company and Turf Nursery is located in Auburn, Alabama.

series of Tifton, Georgia, by Atlanta-based Tech Industries.

As of July, no drastic fall-off had occurred in the demand for sod this fall, despite gloomy building start figures. Sod will again show its relative remoteness to economic conditions. Commercial lawn care has heightened the interest in lawns by homeowners. As homeowners are forced to restrict travel plans, their homes and their lawns become their prize possessions. Unfortunately, sod producers, irritated by an Illinois law which essentially permits a lawn care firm to apply just water during a job, have formed a poor attitude about all lawn applicators. When sod producers could be working with lawn care firms to resod old lawns, they instead are reluctant to recommend a lawn care service to their customers. The care provided by the lawn applicator or the landscape contractor is the best insurance against failure of the sod after installation. Furthermore, these firms could recommend sodding for lawns they see as beyond hope or not up to current turfgrass standards. If a person pays $2,000 to sod his property, he will be willing to pay the $200 per year to take care of it.

Lawn renovation becomes an important factor when building declines. The sod industry should deal with this marketing alternative.

Market Size

Value of sod produced in the U.S. approximates $200 million annually. Seventy percent of this total is cool season sod production. Sod producers harvest between a third to a half of their acreage each year. Total acreage in sod production is estimated at more than 100,000 acres.

By far the most common time for seeding is late August. Some growers may harvest the sod the following summer if they have used netting or pushed the sod through fertilization. This is done only in special cases and usually less than ten percent of the acreage is devoted to accelerated production. If a grower chooses, he will plant a portion of his acreage in the spring, again usually for specific orders. The normal growing cycle remains 12 to 18 months, fall to fall or fall to spring a year later. Whereas monostands of Merion or other Kentucky bluegrass were common in the early 60's, a blend of improved Kentucky bluegrasses is common today. In some cases, creeping red fescues are added for shade and less fertile sites. Research by Dr. Richard Hurley under Dr. Richard Skogley at Rhode Island found ten percent as the optimum percentage of red fescue in a sod mixture.

Although netting could conceivably allow production of perennial ryegrass sods, growers have avoided such production so far. They are sold on the superior sod strength of bluegrass sod and question the winter hardiness of improved perennial ryegrasses for sod. NK-200 has proven cold tolerant in Minnesota, but more research is needed.

In the transition zone, tall fescue is included in many sod mixtures. New fine-bladed tall fescues show promise for this area and perhaps north ern areas once winter hardiness is established.

Zoysiagrass and bermudagrass are available as plugs or sod in the transition zone. Some Virginia sod nurseries produce bermuda and zoysia sod. Much of the original work with zoysia took place at the USDA Research Center in Beltsville, MD.

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WARM SEASON PRODUCTION

Warm season sod production benefits from a longer growing season, turfgrasses that remain aggressive during the summer, and various uses for the product, i.e. plugs, stolons, and sprigs. It is hampered only slightly in that most production is vegetative, requiring planting methods more complicated than seeding.

Warm season turfgrass sod production required different mechanization from cool season turfgrass sod production. Most of this inventiveness came from the Southeast from men such as Ray Jensen of Southern Turf Nurseries, John Beck of Beck Turf Nurseries, and many others who contributed to the organizational effort, like Jim Ousley of Ousley Sod Co. in Pompano Beach, Florida. In California, Toby Grether of Cal Turf provided the West with the drive and technology to develop.

In some respects, turf nurseries in the South preceded sod farms in the North. While pasture sod was still dominant up North in the 30's and 40's, the turf nursery for production of plugs, sprigs and stolons already existed in southern states. However, sod cutting and harvesting technology really caused both northern and southern sod industries the same delay in transition from older, less efficient methods to those which permitted volume production. Furthermore, modern cutting and harvesting equipment is utilized today in sprig and stolon production.

Extremely high germination temperatures for warm season turfgrasses and their ability to spread rapidly strongly favored vegetative production. The only significant use of seed in tropical and semitropical zones is for winter overseeding with rvegrass and more recently rough bluegrass, *Poa trivialis*. There is some use of centipedegrass, bahiagrass, and kikuyugrass seed. It is generally considered that vegetative production maintains genetic purity better than seeding.

Ray Jensen
Founder of Southern Turf Nurseries, one of the largest warm season turfgrass nurseries.

Bermudagrass, St. Augustine, and zoysiagrass are the dominant sod grasses. They form dense, tight sod which performs well under low mowing heights. St. Augustine and zoysia are favored for shaded areas and exhibit good insect resistance. St. Augustine does not withstand traffic as well as zoysia, and not nearly as well as bermudagrass. Bermuda requires higher maintenance however.

Whereas sod competes with seeding in the cool season turfgrass zones, sod competes with plugs, stolons and sprigs in warm season turfgrass zones. Again, time is the big factor. Warmer climates allow year round use of athletic fields. Some repair can be made by spot sodding and plugs, but major damage must be repaired by sodding. To have a field out of play for renovation is considered impractical.

Irrigation is a way of life in the semitropical and tropical zones where fine turf is concerned. If one commits to the expense of permanent irrigation, as many do, the cost of sod is less an issue. Large areas and lower maintenance areas may opt for stolons, sprigs or plugs. Stolons are often applied by hydraulic mulching equipment. Stolons can also be broadcast and crimped into the soil. Sprigs are inserted in slits cut every eight to 18 inches and tamped. Plugs can be planted at the density desired by the customer or planted in one area and used for future plugs after regrowth.

The equipment required for planting plugs and stolons is not generally available. It is provided by the contractor who installs the lawn. The number of manufacturers is very limited.

So, in some respects, sod has a competitive advantage over other methods in the South, advantages which go beyond the instant lawn. A look at the 1974 Agricultural Census indicates turf nurseries in the South average twice the acreage of northern nurseries but average the same as northern growers in sales. Therefore, it takes twice the acreage in the South to receive the same sales as in the North.

Texas followed Florida in sod production of warm season turfgrass, in the late 60's and early 70's. Texturf bermudagrasses are developments of the Texas Agricultural Experiment Station. Growers in Alabama and Georgia appeared to help push southern sod producers into significance. In California, Tobias Grether and John Nunes pushed that state's industry into sod production in the late 60's.

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At a wide variety of locations, in comprehensive trials, Merit Kentucky Bluegrass has proven itself one of the better new varieties on numerous counts.

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Merit was also lauded for its excellent spring color in tests at several locations.

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- NE-57 TESTS IN 1972 — Overall, Merit's rating was superior to that of Pennstar, Fylking, Geronimo, Nugget, Park and Glade.
- Five-year New Jersey trial — Merit out-ranked Baron, Nugget, Kenblue, Park, Delft, Windsor and Geronimo.
- New York trial — Merit ranked above Baron, Kenblue and Park.
- Three-year Ohio trial (two locations) — Location # 1, Merit rated above Nugget, Fylking and Kenblue. Location # 2, Merit's ratings superior to Baron, Nugget, Kenblue and Fylking.
- Four-year Missouri trial — in season-long turf-quality ratings, Merit highest in a field which included Baron, Bristol, Fylking, Nugget, and Bonnieblue.

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PROFILE

Southern Turf Nurseries

One of the success stories of warm season sod production is Southern Turf Nurseries of Tifton, Georgia.

Started in 1950 by Ray Jensen, a soil scientist with the USDA, Southern Turf Nurseries has an amazing record. Located near the USDA Research Center in Tifton where Glenn Burton bred his "Tif" series of bermudagrass, Southern Turf responded quickly to advances in turfgrass breeding. Jensen was the first to produce seed of centipedegrass and is one of three suppliers of the seed today. He and his staff developed the equipment necessary to plant and harvest sprigs of bermudagrass, centipede, and St. Augustine and plugs of zoysiagrass. In 1960, Southern Turf started production of warm season sod.

Jensen's creative and aggressive business sense was continued by the purchase of the company in 1976 by Charles Nash and E.G. Pope of Atlanta, partners of Tech Industries. In 1978, Southern Turf Nurseries entered into an agreement with Anheuser Busch to utilize brewery effluent to irrigate sod fields adjacent to breweries. The first project in Jacksonville, and another to begin soon near the Williamsburg, VA, brewery solve two problems for the makers Budweiser, Busch, and Michelob; that of effluent treatment and fertilizer needs of the farm. The effluent is rich in nitrogen and is naturally percolated through the sod field soil to the water table. The Jacksonville project produces 300 acres of sod.

Another major step for the company is the recent joint project with Lofts Pedigreed Seed Co., the creation of Sunbelt Seeds. Based in Tucker, Georgia, Sunbelt will market a complete line of overseeding mixtures and warm season turfgrass seed. The company plans to provide considerable technical assistance to southern turf managers.

An existing specialty of Southern Turf is its experience with planting southern athletic fields. In 25 years it has planted more than 2,000 sports fields, including the Orange Bowl in Miami, the Atlanta stadium, and part of Augusta National Golf Course. It has exported and planted fields in 15 foriegn countries, including Saudi Arabia, Japan and Israel. It provided much of the stolons for many of Hawaii's famous golf courses.

Today, Southern Turf Nurseries is the largest producer of warm season turfgrasses in the world.

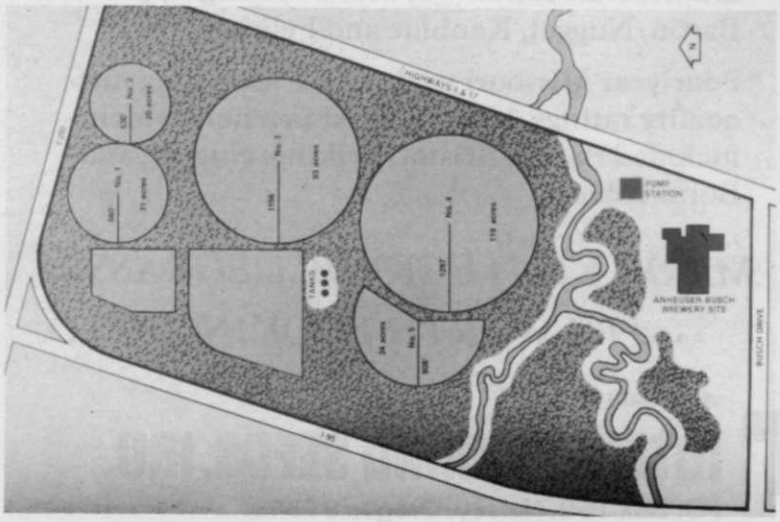

Diagram of effluent project *with Anheuser Busch in Jacksonville, Florida.*

Grether, a tomato and sugar beet farmer in Ventura, CA, planted bermudagrass in part of his acreage in 1958. By 1965, he had 150 acres of sod and 1,100 acres by 1971. Grether is credited with the first net laying devise and the use of fork lifts for sod handling. Today, nearly all of the 1,100 acres is netted. Grether retired in the mid 70's and was followed by Ralph Daily, who improved the net layer and has helped its rise in use today.

According to Daily, the netting permitted planting sod fields that otherwise could not have been planted. Grether's net layer buried the edges of the netting. Daily improved this by a glue applicator for the joining edges of netting.

Warm season sod production faces a greater challenge with offtypes in fields. For example, if bermudagrass gets established in a field of St. Augustine, or visa versa, it must be dug out by hand to remove all viable stolons. Broadleaf weeds are kept under control by herbicides, but grassy weeds require extra effort. Often, mowing crews will spot for offtypes and flag them for control.

Fumigation is very common in warm season sod production and necessary for certified sod. Fields are first fumigated and inspected. Usually, the certified stolons are planted in one foundation block, or field. Other fields are planted by expanding out of that block. The fields are continuously rogued for offtypes. Inspectors make unannounced visits to check the fields prior to harvest.

Irrigation has been essential in the south and west. Large mobile systems are common fed either by wells or lakes. Early proponents and problem solvers in irrigation include Toro's Jim Watson and Weathermatic's Jim Watkins. Fumigation and irrigation are significant in terms of cost to the grower. Without them, however, the job would be nearly impossible.

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Research and the Future

The inventiveness of the sod producer and support entities, i.e. university extension personnel and suppliers, has not diminished. Although the market has matured, demand continues to increase. Lack of appropriate hand labor strongly encourages further mechanization. The cost of water is rising rapidly in some regions encouraging the use of effluent water, efficient irrigation, drainage recovery, water conditioners, more water efficient turfgrasses, and perhaps antitranspirants. Closely associated to water use is disease resistance. The American Sod Producers and the Golf Course Superintendents Association of America support turfgrass pathologists and breeders work toward more disease resistant cultivars. Rising petroleum prices encourage the development of turfgrasses with lower maintenance requirements. This includes lower nitrogen needs, improved disease resistance, and improved insect resistance.

To accomplish all this, support must come from the sod producer made possible by less destructive competitive pricing, cooperation

Examples of inventiveness. *Power slitter for springs invented by Bill Lyons of Canal Fulton, Ohio (left). Two-man spiker circa 1939 (top right). Sprig planter from John Deere circa 1950 (bottom right). Photos by F. V. Grau.*

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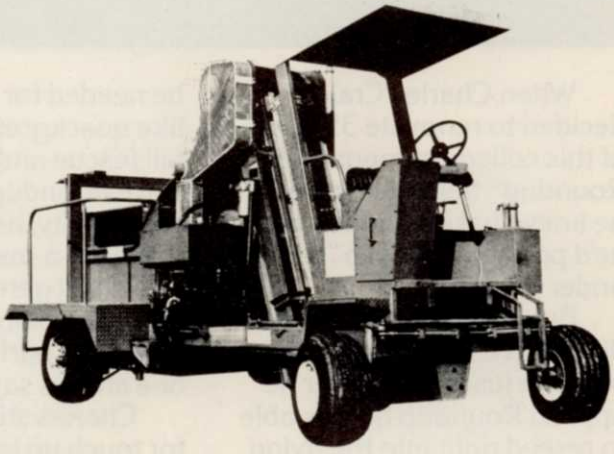
EQUIPMENT

Princeton Turf Equipment

Princeton Turf Equipment originated under the cooperative efforts of Woodrow Wilson of Eastside Nursery in Canal Winchester, Ohio, and Wiley Miner of Princeton Turf Nurseries in New Jersey. Miner displayed the harvester during a turf field day at Rutgers in 1966. An improved version of that harvester became the first Princeton harvester. Today, Princeton has a number of models of harvesters, including an extremely sophisticated large harvester with enclosed cab and minimal sod handling needed. In addition to harvesters, Princeton manufactures a fork lift called the Piggyback and a harvester that is attached to the tractor in an easily detachable hitch arrangement freeing the tractor for other duties. It also makes a turf vacuum and a stolon planter. Princeton designs to serve both cool and warm season sod production.

Wilson says that every harvester he has ever sold is still in use today, attesting to the reliability of his product.



Princeton harvester *can harvest up to 2,500 square yards per hour and has a floating cutterhead for cutting in mineral or peat soils and in rolling conditions.*

The advantage of the Princeton harvester is that the weight of the machine is over the blade, not to the side, according to Wilson. He attributes this and other design advantages to the success of the Princeton harvester. Wilson continues to work on improvements to his harvesters and to develop and manufacture other pieces of sod equipment, such as the fork lift, grass vacuum, and sprigger.

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METRIC SOD

The U.S. conversion to metric, although slow, is occurring. At the same time, sod production technology developed in the U.S. and Canada is going worldwide.

Gerry Brouwer of Brouwer Turf Equipment Ltd. estimates that the demand for improved sod technology will grow in areas still strongly based in pasture sod. Areas such as South Africa, Australia, Holland, Germany and the United Kingdom are buying harvesters.

Canadian sod producers currently sell sod in .8 square meter rolls, which is the same as a square yard. The Nursery Sod Growers Association of Ontario pushed for the conversion to metric in 1978. So golf course superintendents, landscape contractors, and homeowners now must think in terms of meters instead of yards.

Although it would make sense to go to the square meter over the .8 square meter roll, sod producers say the full meter roll is too heavy to handle. Since nearly two-thirds of Ontario's bentgrass sod is sold to U.S. users, the acceptance of metric conversion will spread to northern states quickly.

No talk of converting machinery to the metric units has been proposed. But conversion is eminent and a little lesson in metric is appropriate.

CONVERSIONS:

area in square yards x 1.0451 = the number of 0.8 square meter rolls
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with other turf organizations, and a willingness to try new methods. Marketing techniques can be improved to increase demand, increase price, and solidify the image of sod as the surest way to have a quality lawn. Support to university research is critical, either by individual contributions by estates of those who lived comfortably from the sod industry or by organizational grants. Purchasing new machinery that has been improved, chemicals that make savings possible, and seed that exhibits improved characteristics will provide the commercial sector with the will to experiment and develop new products.

Future sod production will be an agronomically complex skill. It has come a long way from the pasture to the highly mechanized, irrigated, blend and mixture , and chemically complex profession. It has also become a sophisticated business with marketing and planning critical to growth. It will take study in addition to inventiveness to succeed in sod production in the future.

The continuously growing strength of the American Sod Producers Association will play a major role in accomplishing needed research and maintaining commercial interest in the market by suppliers. By making industry statistics available to potential suppliers and showing that its membership is receptive to new ideas ASPA can generate a tremendous commercial interest in sod production. This will encourage private research as well as public research on sod methodology.

ASPA is increasing its service to warm season sod producers in an effort to represent all U.S. growers. Recalling that two of the original five producers behind ASPA were growers of warm season grasses, southern growers should not categorize ASPA as for northern growers only.

Perhaps the most present challenge is marketing of sod. Full participation in the Landscape Industry Association Council (LIAC) could faciliate support from landscape architects and contractors, and to benefit from basic marketing problems of the Green Industry. Sophisticated promotional campaigns and record keeping could extract further market potential for sod. That potential, if realized and funnelled back into research and the supplier will assure continuous growth.

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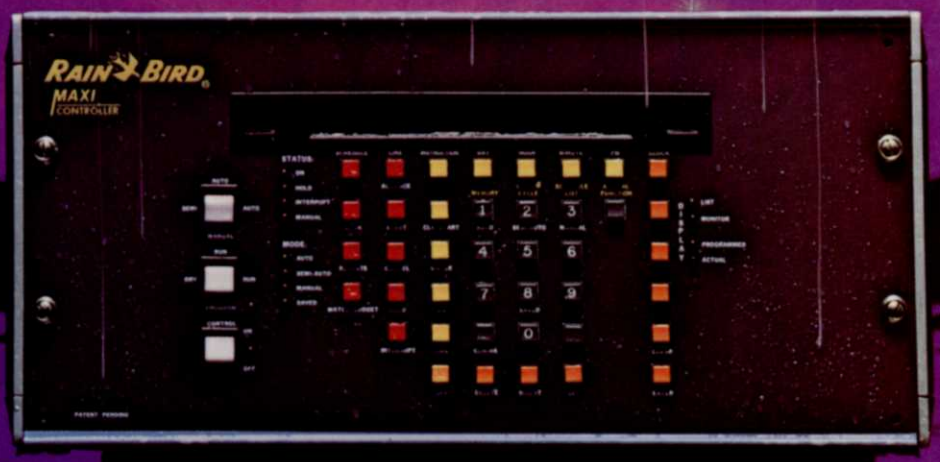

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TURF PAVERS: WEAR PROTECTION WITH AWARENESS OF SPECIAL CARE

By Robert C. Shearman, Turf Specialist, Department of Horticulture, University of Nebraska

Turfs exposed to vehicular traffic are subject to wear injury and compaction stress. The severity of turfgrass injury in heavily trafficked conditions depends upon the traffic type and intensity, turfgrass species or cultivar used, environmental conditions, and the cultural practices employed. Turf managers should select wear and compaction tolerant grasses and employ cultural practices that enhance the ability of turfs to grow under these conditions. In addition to these aspects, physical factors that protect the turfgrass plant from wear and compaction injury may also be used to help turf persist in heavily trafficked areas.

Paver complexes (i.e. concrete, brick, and plastic materials) have been designed as physical support systems for turf growing in areas such as parking lots, firelanes, and golf car paths, where traffic stress may be a problem. Paver complexes are designed to allow the turfgrass plant to grow in void areas while the crown or growing point of the plant are protected from traffic injury by placement below the paver surface or by waffle-like protrusions on the paver surface.

One of these turfgrass-paver complexes was tested at the University of Nebraska Turfgrass Research Facility located at Mead, Nebraska. The paver complex was tested to determine its influence on turfgrass establishment, quality, wear tolerance, and recuperative potential. Information of this nature is needed to help turf managers better understand the advantages and disadvantages of using such a system in heavily trafficked areas.

Six turfgrass species were included in this study: (1) Manhattan perennial ryegrass, (2) Merion Kentucky bluegrass, (3) Kentucky 31 tall fescue, (4) Dawson creeping red fescue, (5) Highlight chewings fescue, and (6) Fairway crested wheat-grass. These species were selected because they were commonly used in Nebraska and they covered a range of wear tolerant and intolerant species. The grasses were established in two areas, one with the paver system and an adjacent area planted in soil (Sharpsburg silty-clay loam). Once the turfs were established, they were mowed weekly at 3.0 inches; watered to prevent drought stress; and fertilized with three pounds of nitrogen (45-0-0) per 1,000 sq. ft. per growing season.

Some of the relative effects of the grass-paver complex on establishment, winter survival, and turf quality are indicated in Table 1. The grass paver complex adversely affected turf quality for Manhattan and Merion but enhanced the quality rating for Fairway crested wheatgrass. The reduced turf quality rating for Merion was primarily due to its slow establishment rate in the paver complex compared to that in the non-paver area. Merion and Fairway established more slowly in the paver complex than the soil area; while Manhattan, Kentucky 31, Dawson and Highlight established equally as well in either area.

Winter survival of susceptible grasses was adversely affected by the grass paver complex during the seedling year. The six species were establsihed in September, 1976. During the following winter, snow cover was lacking and temperatures were ex-

Turf pavers ready for topsoil and seeding in cart path.

tremely low. As a result, Manhattan perennial ryegrass and Kentucky 31 tall fescue were injured by direct low temperature injury in both the paver and non-paver areas, but injury was greatest in the grass-paver complex. Turf managers should be aware of this as a potential problem. Selecting cold tolerant species and cultivars and avoiding late fall plantings should help minimize potential problems from low temperature and desiccation injury.

Wear treatments were applied, using an 18-horsepower Cushman truckster. Each turf was subjected to 600 trips with the truckster over a four hour period. Subsequent wear injury and recuperative rates were evaluated (Table 2). Wear injury from the 600 trips was quite severe, particularly on grasses such as chewings fescue and crested wheatgrass which are wear intolerant species. The grass-paver complex improved turfgrass wear tolerance and recuperative potential for all the turfgrasses except for Merion Kentucky bluegrass. The paver system was most beneficial in helping grasses that were very susceptible to wear injury (i.e. Fairway crested wheatgrass, chewings fescue, and creeping red fescue), but it was even beneficial to those that were fairly wear tolerant. Loss in turfgrass quality (density and uniformity) associated with the paver complex was offset by its improvement in turfgrass wear tolerance and recuperative rate.

Turfgrass-paver complexes can play a beneficial role in maintaining turfgrasses that are exposed to intense traffic, particularly in areas like overflow parking, driveways, cartpaths, walkways, and firelanes. Placement of paver systems, regardless of type or construction, is extremely important. The paver must be situated so that the crown of the turfgrass plant is protected from injury. If the paver system is improperly placed, its purpose is defeated and no improvement in wear tolerance or recuperative rate will be obtained.

Turfgrass-paver complexes are not without management difficulties. Thatch accumulation and its removal could be a problem. Turf managers should select turfgrasses that have a minimum thatching tendency and use cultural practices that reduce thatch accumulation. Snow removal on paver complexes with surface protrusions can be a problem; however, float devices for the snowplow blade minimize the problem. Oil and gas spills can be a problem in parking areas, and repair of damaged areas may be necessary. Increased soil temperatures were thought to be a problem in paver complexes. However, in this study no differences were noted in soil temperatures beneath turfs growing in the paver and non-paver areas. Mowing was not a problem in either area and turfs used similar amounts of water. **WTT**

Table 1. Relative effects of paver complex on establishment, winter survival and turf quality.[1]

Turfgrass Species	Rate of Establishment	Percent Ground Cover	Winter Survival	Turf Quality
Manhattan perennial ryegrass	0	0	-	-
Merion Kentucky bluegrass	-	-	0	-
Kentucky 31 tall fescue	0	0	-	0
Dawson creeping red fescue	0	0	0	0
Highlight chewings fescue	0	0	0	0
Fairway crested wheatgrass	-	-	0	+

[1]Ratings based on + = better than, - = poorer than, and 0 = no different than turfs in the non-paved area.

Table 2. Relative effects of paver complex on wear tolerance and recuperative rate.[1]

Turfgrass Species	Wear Tolerance	Recuperative Rate
Manhattan perennial ryegrass	+	0
Merion Kentucky bluegrass	0	+
Kentucky 31 tall fescue	+	+
Dawson creeping red fescue	+	++
Highlight chewings fescue	++	++
Fairway crested wheatgrass	++	++

[1]Ratings based on + = better than, - = poorer than, and 0 = no different than turfs in the non-paved area.

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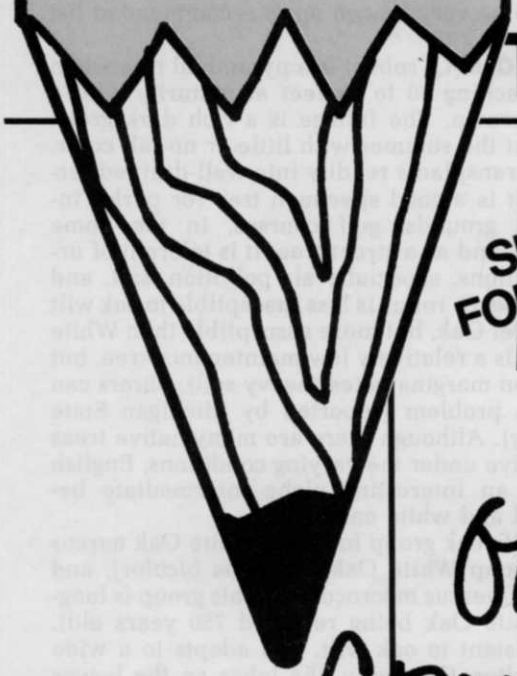

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WHITE OAK RESISTANCE TO WILT COMPARED TO RED OAK COLOR, SPEED

By Douglass Chapman, Horticulturist, Dow Gardens, Midland, MI.

Oak *(Quercus)*, a sun-loving tree, is the most important hardwood timber genera in the United States. It should be one of the most important shade tree groups in production today. When considering optimal growing, oak species are adapted to conditions varying from droughty upland sites to flood plains. Quercus species are variably tolerant to urban stress, air pollutants (ozone and sulfur dioxide), salt (chlorides), and disease. I would like to discuss the oak in two accepted groups — red and white oak.

The red oak group includes Scarlet Oak *(Quercus coccinea)*, Northern Red Oak *(Quercus rubra)*, Black Oak *(Quercus velutina)*, Pin Oak *(Quercus palustris)*, and English Oak *(Quercus rubur)*. In general, this group grows more rapidly with a shorter life span while showing acute susceptibility to oak wilt when compared to the white oak group.

Scarlet Oak *(Q. coccinea)* is a rapid growing (2-3 feet per year) upland tree species. It grows well in moist, well-drained soil. *Q. coccinea* has an upright, oval habit of growth, reaching 60-75 feet in the landscape. The foliage is a glossy green throughout the summer with an effective soft red yet variable fall color. It transplants easily as it exhibits little or no tap root. When considering advantages, Scarlet Oak is the most rapid growing oak and shows moderate tolerance to ozone and highway salts. *Q. coccinea* is effective as a street tree as well as a specimen in golf courses and institutional grounds. Its disadvantages include a relatively short lifespan (70-80 years), extreme susceptibility to oak wilt, and high maintenance requiring pruning every 3-4 years.

Red Oak *(Q. Rubra)* is a good street, park, golf course, industrial, and home landscape specimen tree. Its foliage is shiny green throughout the summer, becoming bright red in the fall. This rounded tree ultimately reaches 60-70 feet in height, with some individuals in the wild reaching over 110 feet in height. Red Oak transplants readily into moist, yet well-drained soil. *Q. rubra* is tolerant of urban conditions, e.g., salt, ozone, and sulfur dioxide. The main disadvantage of Red Oak is its extreme susceptibility to oak wilt, which should limit the use of it in areas where this disease is active. Further, when using this tree in the landscape, it should be limited to less than 5% of the street trees in any one locale, thus avoiding catastrophic problems similar to those of American Elm.

Black Oak *(Q. Velutina)* is second only to White Oak in a broad native range which is essentially from the Great Plains - East, excluding small parts of Texas and Florida. It has a broad oval crown, reaching 50-60 feet in height. *Q. velutina's* dark green leaf of summer makes it a valuable specimen. It grows rapidly in well-drained, upland sites, while transplanting with relative ease up to 2 inches in diameter. It is shade intolerant; therefore, is a good specimen tree in full sun. It can be used in institutional grounds, parks, or in golf courses. Black Oak is often found associated with Scarlet Oak and hybridizes readily. It exhibits many of the same environmental tolerances as Scarlet and Red Oak. It should become a more valuable tree in the trade.

Pin Oak *(Q. palustris)* displays a pyramidal habit of growth, reaching 60-70 feet in height. This tree, with a strong central leader and horizontal branches (rarely over 20 feet in length) has great eye appeal for individual home landscapes. This is a relatively short-lived tree, when considering oaks rarely live over 80 to 90 years. Pin Oak thrives in very poorly-drained, acid soils. It has been used as a street tree but is almost always a disappointment. Pin Oak may have a place as a native tree in golf courses, parks, and industrial grounds, but should not be used in the home landscape or as a street tree. Its disadvantages include extreme susceptibility to oak wilt, moderate susceptibility to ozone and salt spray and iron chlorosis (deficiency) on disturbed sites, which include almost every landscape. Dr. Smith at Ohio State University has reported iron citrate implants overcoming the problem of iron chlorosis but considering the high maintenance requirements, disease susceptibility, and urban environment intolerance, this ornamental should be very low on one's recommended list of trees.

English Oak *(Q. robur)* is a pyramidal tree when young, reaching 70 to 80 feet at maturity with a rounded crown. The foliage is a rich dark green throughout the summer with little or no fall color. This oak transplants readily into well-drained fertile soil. It is a good specimen tree for parks, institutional grounds, golf courses, in the home landscape, and as a street tree. It is tolerant of urban conditions, especially air pollution, salt, and anthracnose. *Q. robur* is less susceptible to oak wilt than Scarlet Oak, but more susceptible than White Oak. This is a relatively low maintenance tree, but it grown on marginal sites (heavy soil), borers can become a problem (reported by Michigan State University). Although there are many native trees which thrive under the varying conditions, English Oak fills an interesting niche intermediate between red and white oaks.

The white oak group includes White Oak *uercus alba)*, Swamp White Oak *(Quercus bicolor)*, and Bur Oak *(Quercus macrocarpa)*. This group is long-lived (White Oak being reported 750 years old), fairly resistant to oak wilt, and adapts to a wide range of sites. Generally, the lobes on the leaves are obtuse or oval for the entire white oak group.

White Oak *(Q. alba)* is native to an extensive geographic range in all areas east of the Great Plains. This plant is valuable for its lumber as well as an exciting landscape specimen. The habit is pyramidal when young, becoming an 80-foot oval at maturity. The leaves are a bluish-green throughout the summer and change to rich red to brown in fall. White Oak transplants easily when young (under 1½ inches in diameter) into fertile, well-drained

Scarlet Oak *Quercus coccinea* is the most rapid growing oak and transplants well, requires pruning every three to four years.

Bur Oak *Q. macrocarpa* has the benefits of a white oak and is a promising low maintenance tree if transplantability can be improved.

soil. Flooding, even for a short period of time, can cause decline in White Oak, as in the Chicago area due to extremely wet periods during the early 1970's. Researchers at the University of Illinois report that White Oak has a very shallow fibrous root system which doesn't compete favorably with grass. This indicates that a good companion plant for White Oak or, in fact, many of the oak would include pachysandra or myrtle as a ground cover rather than turf. White Oak is a good specimen tree which should be grown in full sun, in parks, golf courses, or on institutional grounds. It is the state tree of Illinois. The advantages of White Oak include resistance to ice breakage, good tolerance to highway salt, high degree of resistance to oak wilt, longevity, and low maintenance. This is such a low maintenance tree that no more than one or two prunings are needed for the life of the planting. The main disadvantages of *Q. alba* include oak anthracnose (Gnomonia species) and a slight susceptibility to ozone and sulfur dioxide as reported by Davis and Gerhold. White Oak should still be considered a high value, low maintenance specimen for large area landscapes.

Swamp White Oak *(Q. bicolor)* adapts well to rich, acid-wet soils found in flood plains. It is outstanding as a specimen for golf courses, institutional grounds, parks, and the home landscape. *Q. bicolor* has a somewhat open, round crown which reaches 50 to 60 feet in height. The summer leaves are dark green on the upper surface with a dull or silver-green lower surface. Swamp White Oak is sensitve to highway salts and is not easy to transplant in larger sizes, but comes with all the advantages of White Oak while tolerating high moisture soils. It certainly should be used more extensively in large area landscapes.

Bur Oak *(Q. macrocarpa)* has an oval habit, reaching 80 to 90 feet in height. The plant adapts well to urban conditions, being tolerant of highway salts and ozone. It adapts well to many soil types while thriving in calcerous, well-drained, almost droughty soil. It does have a pronounced tap root, therefore, does not transplant easily. Research should be initiated to understand and improve ease of transplantability for this otherwise outstanding tree. The foliage is dark green on the upper surface with a white tomentose on the underside, turning yellow to brown during late fall. The trunk is massive with a thick bark (4 inches), which makes it very fire resistant—a survival factor in its native range of the Great Plains. It is one tree which competes well with grass for nutrients and water; therefore, it can easily grow in fine turf areas. It carries most of the desirable characteristics of White Oak, thrives in urban conditions, and is a low maintenance tree (requiring little pruning after establishment).

Oaks are an exciting genera which could be more effectively used in the landscape. Their native range is extensive throughout the entire Northeastern and Eastern United States. They grow in soils ranging from heavy clays to well-drained. Generally, many of the plants display good tolerance to urban conditions and are aesthetically outstanding. Most oaks are poor competitors with turf; therefore, ground covers, such as pachysandra or myrtle, would be good companion plants. All oak types have not been readily available from the trade because of their difficulty in transplanting. Research is appropriate in the areas of mychorrhizae, transplant ability, propagation by cuttage of selected cultivars, and the development of area trees, e.g., Great Lakes or New England States White Oaks. We must realize that provenance, local adaption, plays an important role in the survival of many oak transplants. Oak should headline the list of desirable adaptive trees for landscape architects, nurserymen, and urban foresters. **WTT**

VEGETATION MANAGEMENT

By Roger Funk, Ph.D., Davey Tree Expert Co., Kent, Ohio

Q: *Why is coring supposed to be better than spiking to relieve compaction? Both techniques provide a channel for better air exchange and water penetration.*

A: An ideal soil contains 50 percent pore space which allows for proper penetration and availability of air and water. When a soil becomes compacted, the particles are pressed closer together reducing the pore space, and in effect creating a situation where the soil contains too much particulate matter and not enough space.

To relieve compaction, then, you should remove some of the soil matter which can be accomplished by coring. Spiking, however, does not remove any soil but simply rearranges it. In fact, spiking can aggravate compacted soils by causing additional compaction around the edges of the hole.

Q: *What is LB urea? Can it be used to fertilize turf?*

A: "LB" is commonly defined as urea with less than 0.25% biuret. It can be used for either foliar or soil fertilization of turfgrasses.

Q: *How can you control crabgrass in dichondra?*

A: Betasan (Bensulide) can be used for preemergent control of crabgrass on seedling or established dichondra.

Q: *Will insecticides in a lawn application kill slugs?*

A: Liquid fertilizers might desiccate slugs but I am not aware of any insecticide effect. The standard recommendation is metaldehyde/Mesurol bait or a shallow (¾-inch) pan of beer placed in areas of high feeding activity.

Q: *How large should the soil ball on a 15-foot hemlock be?*

A: According to the American Standard for Nursery Stock, the diameter of the ball of a 14 to 16-foot pyramidal evergreen should be 42 inches and the depth should be not less than 60 percent of the width. The American Standard for Nursery Stock is published by American Association of Nurserymen, 230 Southern Building, Washington, DC 20005.

Q: *Can St. Augustine be hydro-sprigged with a Bowie 350 machine?*

A: Because of limited and inconsistent success, it is not recommended that St. Augustine be vegetatively established by the hydromulch process.

Q: *Is it possible that a low seeding rate—one pound per 1,000 square feet—is successful? What would be a suitable rate for a mixture in New England?*

A: The seeding rate would depend upon the turfgrass species included in the blend or mixture as well as seed viability, establishment procedures, and environmental conditions.

In general, Kentucky bluegrass blends are seeded at a rate of 1 to 2 pounds per 1,000 square feet, although certain of the new improved cultivars have been established successfully at rates as low as 0.5 pounds per 1,000 square feet.

Seeding rates for other cool-season turfgrasses are listed below:

Species	Seeding rate (Lbs./1,000 sq. ft.)
red fescue	3-4
tall fescue	7-9
perennial ryegrass	7-9
bentgrass	0.5-1

The proper seeding rate for mixtures of two or more species is determined by the ratio or percent of each species in the mixture.

Q: *In attempting to establish centipede grass from seed, what is the best method to control crabgrass? Since centipede takes several weeks of constant moisture for germination, the crabgrass gets a tremendous head start, thus inhibiting the centipede grass.*

A: The best method of crabgrass control when establishing centipede grass from seed is to fumigate prior to seeding. Pre-emergent herbicides cannot be used until the grass becomes established, by which time crabgrass has also become established. There are no post-emergents currently labeled although Metribuzin (Sencor—registered trade name of Mobay Chemical Corp.) has given favorable results in research tests.

An alternative would be to establish centipede grass vegetatively and follow immediately with an application of Atrazine (AAtrex—registered trade name of Ciba-Geigy Corp.).

Q: *Residents surrounding a lake were questioning one of my employees about whether or not our lawn service could cause eutrophication. What is your opinion?*

A: Eutrophication is a condition in stagnant ponds characterized by a dense growth of plant life, the decay of which depletes the shallow waters of oxygen in the summer.

Except in a few isolated cases, there is no evidence that fertilizers are a major cause of eutrophication. In fact, studies have shown that in areas where severe water pollution exists, the removal of all fertilizer nitrogen and phosphorus would not prevent eutrophication.

pots 19 percent; larger containers 12 percent; and hanging baskets 19 percent of the total foliage plant sales.

The majority of foliage plants sold by retailers come from outside sources, rather than company-grown stock, according to the survey results.

ELECTIONS

Howell new president of Perlite Institute

William R. Howell, Perlite Ore products manager of the Minerals Division, Grefco., Inc., Oak Brook, IL, was elected President of the Perlite Institute at its 31st annual meeting.

Howell, who has been associated with the Perlite industry since 1946, last year received the Lewis Lloyd award, which is the highest honor that is granted by the industry.

The Perlite Institute is an international trade association of producers, expanders, and applicators. Members in 22 countries establish product standards and specifications and encourage the development of new products through research and marketing activities.

INDUSTRY

OPEI reports increase in power products

Industry shipments of lawn and garden power products have increased 4.7 percent this year in an eight-month period from September, 1979 through April, 1980, according to estimates made by the Outdoor Power Equipment Institute (OPEI).

The largest increase estimated by OPEI was in the shipments of the walk-behind rotary tillers, which was 11 percent over last year's units. Walk-behind power lawn mowers increased 4.5 percent.

Although garden tractor shipments registered a small decline, lawn tractors and riding mowers grew 3.6 percent. Front-engine riders advanced 3.6 percent and rear-engine riders 2.6 percent.

FERTILIZERS

Allied Chemical plans big research program

Allied Chemical Corporation is planning a $3.4 million fertilizer "forward research" program with $1.2 million of it going to foliar fertilizer technology research.

According to Dr. Ramon Garcia, manager of Agricultural Research and Development, part of Allied's fundamental fertilizer research projects will concentrate in the areas of energy conservation, fertilizer efficiency, and breakthrough technology for yield increases.

Garcia says, "The company may add substantial research dollars during the decade to develop new fertilizer technology that will be needed to deal with increasing demand for world food supplies, rising energy costs, and fertile soil losses."

Another important portion of the "forward research" program, says Garica, is that it will be carried out by universities across the country, under grants from Allied Chemical.

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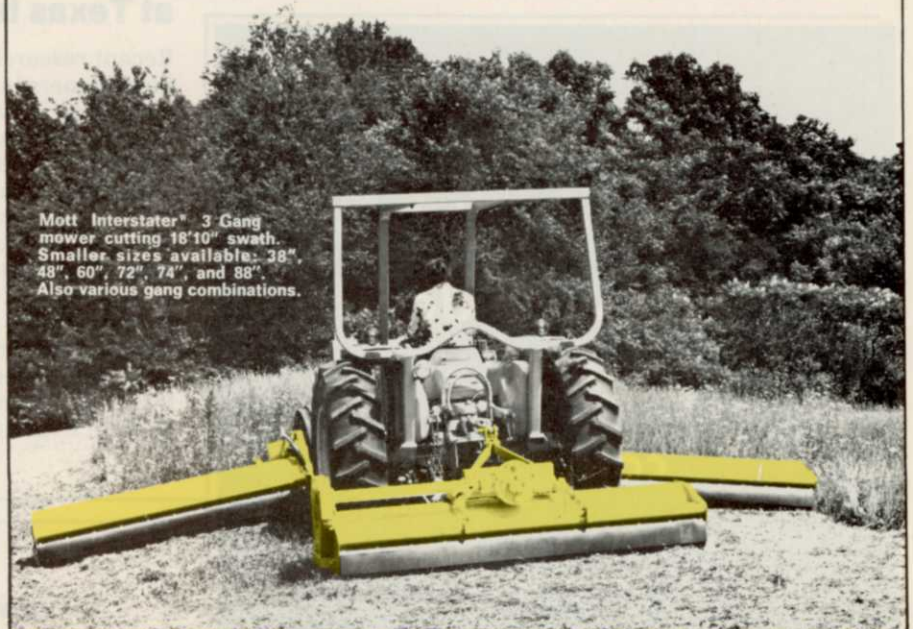
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SOD PRODUCER NEWS

Volcanic ash doesn't seriously affect Washington sod growers

Washington sod growers, hit hardest by the eruption of Mount St. Helens, did not suffer much from volcanic ash, although complications are still arising from its remains.

Most of the state's sod growers live east of the Cascade Mountains and away from the heaviest streak of ash which dropped across the center of the state. This area still shows the remnants of a snowfall of material like talcum powder that is beginning to kill some lawns and create an unsightly crust on others.

Clark & Sons, a grower in Spokane, has received calls from homeowners in selling areas 30 to 80 miles away since they discovered their lawns were insured. A heavy rain in the area after the ash fell turned it into an impenetrable crust that blocked sunlight and additional water from the turf.

Dr. Roy Goss, a research turf agronomist with the Western Washington Research and Extension Center in Puyallup, said the impact on the sod grower was very minimal. He said a grower in Castle Rock, north of Portland, OR, had just seeded and netted his farm when the third eruption hit. He was forced to take up the netting, plow the ash over, and reseed— a costly project.

Except in this area and the Moses Lake-Ritzville area in central Washington, the ash filtered fairly well into the ground. Its potash, iron, and small amounts of phosphorus are useful to the soil. Yet it is "physically very poor— structureless—and may require more aerifying and maybe wetting agents to reduce surface tension and let water filter in," says Goss.

A high iron and zinc content could cause a slow death, says Dale Kenyon, owner of Elite Sod Farm in Richland. "If it had turned hot after, it would've caused a lot of damage." He said a 9-square-foot roll, which normally weighs 25 to 30 pounds, is weighing 60 to 70 pounds and becomes impossible to harvest.

Because of its abrasiveness, the ash has damaged tractor blades and ruined motors. Farmers have increased lubrications and oil changes and promptly replaced clogged air filters.

Pros view research results at Texas turfgrass field day

Recent research shows that more than two million homeowners in Texas maintain turfgrasses and are interested in ways to do a better job at it, professionals were told who attended a turfgrass field day at Texas A&M University in May.

Statistics total the land area with turfgrasses for functional, recreational, and aesthetic purposes at about 3.1 million acres. It costs about $620 million each year to establish and maintain these turfs.

"Energy and non-renewable resources devoted to maintaining all these turfgrasses will be of increasing concern as supplies become more limited and costs increase," said Dr. James Beard, professor of turfgrass physiology with the Texas Agricultural Experiment Station and Texas A&M.

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EVENTS

The current issue of WEEDS TREES & TURF carries meeting dates beginning with the following month. To insure that your event is included, please forward it, 90 days in advance, to: WEEDS TREES & TURF Events, 9800 Detroit Ave., Cleveland, OH 44102.

2nd Exhibition for Horticulture and Landscape Construction, "Gruen 80," Basel, Switzerland, **thru Oct. 12.** Contact Beat Baechler, 104 South Michigan Ave., Chicago, IL 60603, 312/641-0050.

Farwest Nursery Garden & Supply Show, Seattle Center Coliseum, Seattle, WA, **Aug. 24-26.** Contact Dan Barnhart, Farwest Nursery Show, 224 S.W. Hamilton St., Portland, OR 97201, 503/221-1182.

International Symposium on Inland Waters and Lake Restoration, Portland, ME, **Sept. 8-12.** Contact Dr. Ann N. Clarke, Project Manager, Associated Water and Air Resources Engineering, Inc., P.O. 40824, Nashville, TN 37204, 615/794-0110.

Ohio Turf and Landscape Day, Ohio Agricultural Research and Development Center, Wooster, OH, **Sept. 9.** Contact Dr. Dave Nielsen, OARDC, Wooster, OH 44691, 216/264-1021.

Northern Michigan Turfgrass Field Day, Traverse City Golf and Country Club, Traverse City, MI, **Sept. 9.** Contact Thomas M. Smith, 323 Agriculture Hall, Michigan State University, East Lansing, MI 48824, 517/353-4417.

International Exhibition of Groundsmanship, University of London Athletic Grounds, Motspur Park, New Malden, **Sept. 9-11.** Contact British Information Services, 845 Third Ave., New York, NY 10022, 212/752-8400.

University of Illinois Turfgrass Research Field Day, Ornamental Horticulture Research Center, University of Illinois, Urbana, IL, **Sept. 10.** Contact Dr. David Wehner, Room 10, Horticulture Field Lab, Urbana, IL 61801.

Interior Landscape Div. Conference, Denver, CO, **Sept. 10-12.** Contact John Shaw, Executive Director, ALCA, 1750 Old Meadow Rd., McLean, VA 22101, 703/821-8611.

The Interior Plantscape Annual Meeting/Trade Show, Hyatt Regency Hotel, Dallas, Texas, **Sept. 11-14, 1980.** Contact Interior Plantscape Association, Stephen R. Arkin, Managing Director, 11800 Sunrise Valley Drive, Reston, VA 22091, 703/476-8550.

6th Annual Garden Industry of America Conference Trade Show, Convention Center, Baltimore, MD, **Sept. 12-14.** Contact Garden Industry of America Conference & Trade Show, Box 1092, Minneapolis, MN 55440, 612/374-5200.

International Public Works Congress and Equipment Show, H. Roe Bartle Hall, Kansas City, MO, **Sept. 13-18.** Contact Robert Bugher, Executive Director, APWA, 1313 East 60th Street, Chicago, IL 60637, 312/947-2520.

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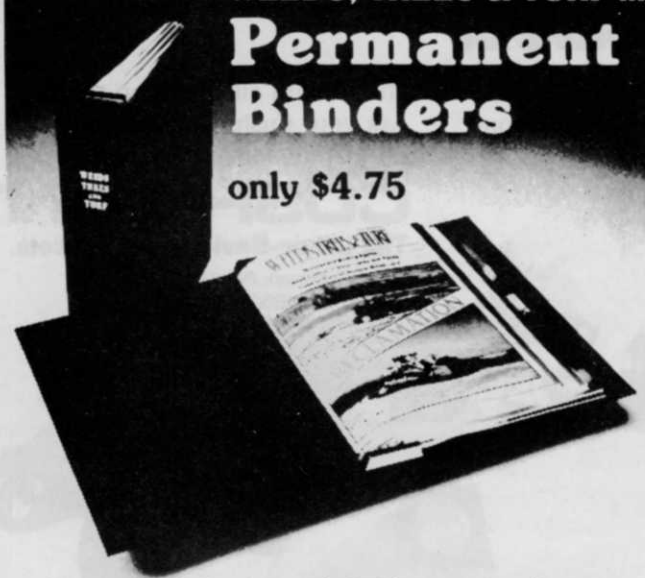

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Tree Care—Urban Forestry Foreman Training, Kent, OH, **Sept. 15-26.** Contact Richard E. Abbott, Davey Environmental Services, 117 South Water Street, Kent, OH 44240, 216/673-9511.

Tree Diagnostic and Evaluation Workshop, Holiday Inn, 328 West Lane Ave., Columbus, OH, **Sept. 15-17.** Contact Alan D. Cook, Executive Director, Ohio Chapter, ISA, The Dawes Arboretum, 7770 Jacksontown Rd., S.E., Newark, OH 43055.

VPI & SU Turfgrass Research Field Days, Turfgrass Research Center, Blacksburg, VA, **Sept. 16-17.** Contact John R. Hall, III-Extension Specialist, Turf VPI & SU, 426 Smyth Hall, Blacksburg, VA 24061, 703/961-5797.

Drip Irrigation Short Course, Orlando, FL, **Sept. 16-18.** Contact The Irrigation Association, 13975 Connecticut Ave., Silver Spring, MD 20906, 301/871-8188.

Pacific Horticultural Trade Show, Long Beach Convention Center, Long Beach, CA, **Sept. 16-18.** Contact PHTS Manager Richard C. Staples, 1419 21st Street, Sacramento, CA 95814, 916/443-7373.

National Lawn and Garden Distributors Association Annual Convention, Century Plaza, Los Angeles, CA, **Sept. 16-19.** Contact Lawn and Garden Distributors Association, 1900 Arch Street, Philadelphia, PA 19103.

Residential Design Course II, Milwaukee, WI, **Sept. 17-19.** Contact John Shaw, Executive Director, Associated Landscape Contractors of America, 1750 Old Meadow Rd., McLean, VA 22101, 703/821-8611.

Interior Plantscape Association annual meeting, Hyatt Regency Hotel, Dallas, TX, **Sept. 18-21.** Contact Ms. Carol Felix, Executive Director IPA, 11800 Sunrise Valley Drive, Reston, VA 22091, 703/476-8550.

Fertilizer Institute World Fertilizer Conference, Hyatt Regency, San Francisco, CA, **Sep. 21-23.** Contact Barbara Schoen, The Fertilizer Institute, 1015 18th St. NW., Washington, DC 20036, 202/466-2700.

Northwest Turfgrass Annual Conference, Sunriver Lodge, Sunriver, OR, **Sept. 22-25.** Contact Dr. Roy Goss, Executive Secretary, Northwest Turfgrass Assn., Western Washington Research and Extension Center, Puyallup, WA 98371, 206/593-8513 .

Rocky Mountain ISA chapter meeting, Denver Botanical Gardens, Denver, CO, **Sept. 24-25.** Contact Ervin C. Bundy, ISA Executive Director, P.O. Box 71, 5 Lincoln Square, Urbana, IL 61801, 217/320-2032.

The Florida Growin' Show, State Fairgrounds Expo hall, Tampa, FL, **Sept. 26-28.** Contact Fla. Nursery & Allied Trades Show, P.O. Box 16796, Temple Terrace, FL 33687.

70th Annual California Association of Nurserymen's Convention, Konocti Harbor Inn, **Sept. 30-Oct. 2.** Contact Richard Staples, California Association of Nurserymen, 1419 21st Street, Sacramento, CA 95814, 916/448-2881.

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Central Plains Turfgrass Foundation, Kansas State University Turf Conference, KSU Union, Manhattan, KS, **Sept. 30-Oct. 2.** Contact Dr. R.N. Carrow, Secretary/Treasurer, Horticulture Dept., Waters Hall, Kansas State University, Manhattan, KS 66506, 913/532-6170.

International Pesticide Applicators Association Annual Convention, Sea-Tac Red Lion Motor Inn, 18740 Pacific Highway South, Seattle, WA, **Oct. 1-3.** Contact William Harlan, P.O. Box 681, Kirkland, WA 98033, 206/823-2600.

Bedding Plants Incorporated Trade Show, Marriott Hotel, Atlanta, GA, **Oct. 4-7.** Contact BPI, Box 286, Okemosm, MI 48864, 517/349-3924.

Mid-Atlantic ISA chapter meeting, U.S. National Arboretum, Washington, DC, **Oct. 5-7.** Contact Ervin C. Bundy, ISA Executive Director, 5 Lincoln Square, P.O. Box 71, Urbana, IL 61801, 217/320-2032.

Tissue Culture Techniques for Plant Propagators, W. Alton Jones Cell Science Center, Lake Placid, NY, **Oct. 6-8 and 9-11.** Contact Course Secy., Cell Science Center, Lake Placid, NY 12946, 518/523-2427.

Aquatic Toxicology Symposium, Philadelphia, PA, **Oct. 7-8.** Contact J. Gareth Pearson, U.S. Army Medical Bioengineering Research and Development Laboratory, Ft. Detrick, Fredrick, MD 21701, 301/663-7207.

16th Annual Turfgrass Equipment, Irrigation, and Supplies Field Day, Rutgers Stadium and Golf Course, Rt. 18, Piscataway, NJ, **Oct. 7.** Contact Dr. Henry W. Indyk, Executive Director, Soils & Crops Dept., P.O. Box 231-Cook College, New Brunswick, NJ 08903, 201/932-9453.

Centor Pivot Irrigation Short Course, Lincoln, NE, **Oct. 7-9.** Contact The Irrigation Association, 13975 Connecticut Ave., Silver Spring, MD 20906, 301/871-8188.

Minnesota Park Supervisors Association fall meeting, Red Wing, MN, **Oct. 10-11;** and winter meeting, Washington County Park Dept., **Dec. 2.** Contact Thomas Feltl, M.P.S.A. Secretary, 8200 Wayzata Blvd., Golden Valley, MN 55427.

New England ISA chapter meeting, Berkshire Hilton Inn, Pittsfield, MA, **Oct. 12-14.** Contact Ervin C. Bundy, ISA Executive Director, 5 Lincoln Square, P.O. Box 71, Urbana, IL 61801, 217/320-2032.

Symposium on Turfgrass Insects, Columbus, OH, **Oct. 14-15.** Contact Dr. B.G. Joyner, Plant Diagnostic Labs, ChemLawn Corp., 6969 Worthington-Galena Rd., Suite L, Worthington, OH 43085, 614/885-9588.

Southwest Turfgrass Association Annual Conference, New Mexico State University, Las Cruces, NM, **Oct. 16-17.** Contact Arden Baltensperger, New Mexico State University, Agronomy Dept., Box 3-Q, Las Cruces, NM 88003, 505/646-3138.

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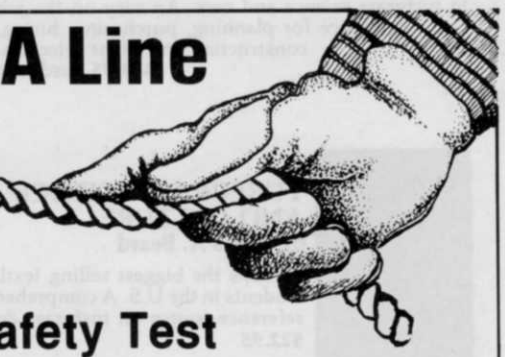

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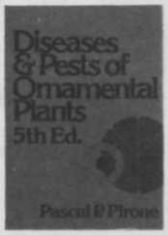

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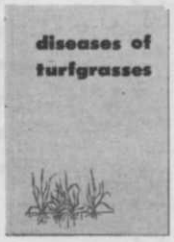

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by Ken Smith, LA

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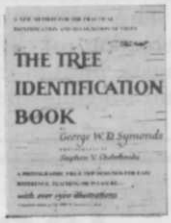

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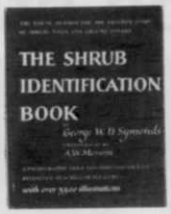

SHRUB IDENTIFICATION
by George Symonds

Pictorial key to identify shrubs. Contains more than 3,500 illustrations to check specimens. Popular and botanical names are given for each shrub with handy index tabs for quick reference.
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PRODUCTS

Towable, rough-terrain fork lifts from K-D Manufacturing Co. have rated capacities from 5,000 through 8,000 pounds. The 680 Series features the Ford industrial power train, unitized

frame and body, and torque converter with power reversing transmission. Standard equipment includes side shifter, full time power steering, disc brakes, differential lock, overhead guard, work lights, and load backrest.

The company offers a wide selection of lift heights in roller masts, built of interlocking channels and I-beams that roll on heavy-duty, sealed-for-life bearings for less friction and no external lubrication. There's also a choice of gas, diesel, or LPG engines.

Write 701 on reader service card

Don Savage Co., Inc. manufactures a one-man post hole digger that operates from any car, truck, or tractor 12-volt system. Battery clamps on this Red Head Digger are 20-foot flexible leads and make jobs easy to reach. The easy handling tool is lightweight and well balanced with a trigger-type, on-off switch built in the handle.

Straight-line power thrust of the 2-horsepower Prestolite motor from armature to auger tip makes efficient use of the tool's power and weight. This helps the digger work fast and be easy to control. Augers come in 3, 4, 5, 6, and 7 inches in diameter. The standard length auger digs holes at least 32 inches.

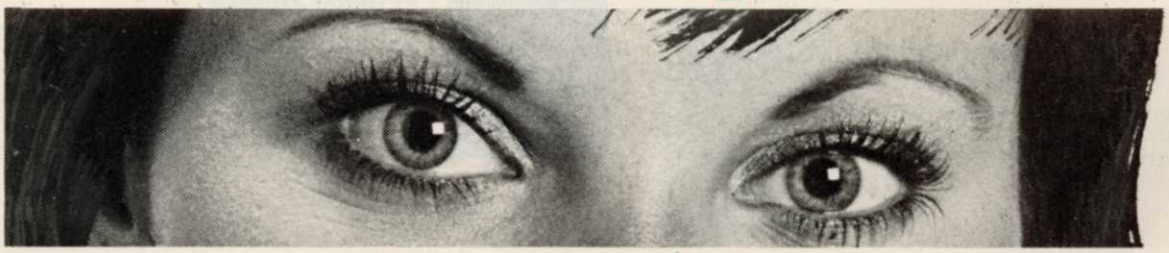
Write 702 on reader service card

A hydro-mulcher from Bowie Industries, Inc. covers distances up to 200 feet without clogging the pump lines and can seed over three acres in 15 minutes. A one-step application plants, seeds, sprigs, fertilizes, waters, sprays, and mulches. Its triple agitators make mixing faster, eliminating sediment build-up.

Along with Ag-Chem Equipment Co.'s Ag-Gator 2004 all-terrain

chassis, the hydro-mulcher can traverse remote areas where large trucks can't reach and where truck tires might harm existing ground cover. The four-wheel drive Ag-

Jacklin Seed says, "Take a good look at this star performer."



Adelphi
KENTUCKY BLUEGRASS
U.S. Plant Patent 3150

Adelphi Kentucky bluegrass was chosen by the Plant Variety Protection office in the U.S. Dept. of Agriculture as the standard green color with which all other bluegrasses applying for plant protection will be compared. Adelphi's rating against 60 varieties in ten-year tests: OUTSTANDING OVERALL PERFORMANCE. Jacklin is a primary producer of Adelphi. For information, contact:

Jacklin Seed Company
West 17300 Jacklin Avenue, Post Falls, ID 83854

Write **130** on reader service card

Gator can carry payloads from 11,360 to 35,700 pounds with 40 degree articulation joints, which permit 12 degree oscillation for stability with a turning radius of less than 26 feet.

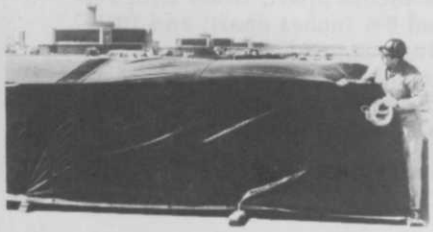
Write 714 on free information card

Sod cutters, which manually clamp onto either backhoe or loader buckets, quickly cut sod to a uniform thickness and slice it into easily handled strips. Two models, 27 and 40,

made by Guest Industries, Inc., cut 27 and 40 inches wide, respectively. Mounting clamps are movable to avoid bucket teeth. The lower cutting assembly (slides and blade) is free to rotate about the upper support assembly, so that it can follow ground contour and also be unaffected by changes in bucket angle.

Write 706 on reader service card

Woven plastic tarpaulins can solve outdoor storage and shipping problems and can also be used for work shelters, scaffolding enclosures, and divider curtains. This flat-tape polyolefin has a 2-mil extruded coating on both sides of the 10 by 10 count closed-weave, which makes it com-



pletely waterproof and resistant to delamination. They are lightweight and flexible yet have more than 725 pounds of rip strength per square foot. Tarpaulins are available in a variety of stock sizes and colors with fire retardant options from Allen Systems Inc.

Write 711 on free information card

Hold/Gro, a combination of knitted yarns interwoven with strips of biodegradable papers, protects the soil until vegetation is firmly established. It shields soil from damaging rainfall and acts as a mulch material. Its yarns serve as a temporary root structure. The material is light enough for two men to install. Gulf States Paper Corp. makes it for use in a wide variety of applications and locations.

Write 710 on free information card

Multipurpose broadcast spreader will quickly and accurately distribute pelleted or granular fertilizers, herbicides, insecticides, and field and grass seed. A 6-point calibrated scale shutter adjusts the rate of material; operator easily sets rate of flow by size of the material. A self-agitator assures even flow. Adjusting rudders in the discharge opening determines the direction of broadcast and saves waste of spread material. Simple structure eliminates possible breakdown.

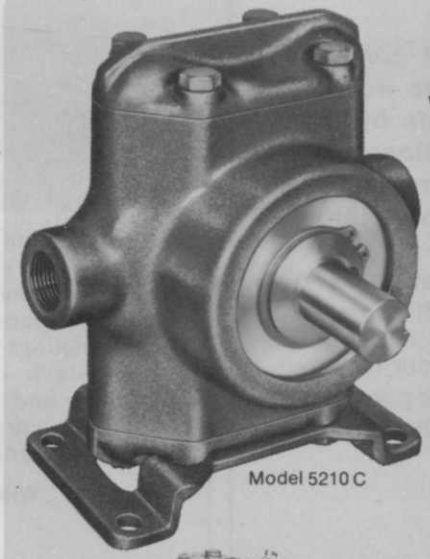
Spreader is 9¼ inches by 16¾ inches by 16 inches high; it weighs

4½ pounds. It has a hopper capacity of one bushel and a spread width of 20 feet. All exposed parts are made of stainless steel or non-breakable scratchless polyethylene materials to prevent corrosion. Warren's Turf Nursery is distributing it.

Write 708 on reader service card

Dedoes Industries, Inc. makes a hand-operated sand plow for easy attachment to the Easy Rider. The rugged plow effectively moves sand and levels cart paths.

Write 707 on reader service card


Model 5210 C

For both Volume and Pressure

Use Hypro series 5200 Big Twin piston pumps.

Here's a rugged two-cylinder piston pump that will deliver up to 10 gpm at 400 psi (600 rpm) for tree spraying, area spraying, fogging, or termite pretreating.

Handles many kinds of weed and pest control chemicals including wettable powder suspensions.

Available with solid shaft or with hollow shaft for direct tractor, truck, or jeep PTO mounting.

FEATURES:
Leather or impregnated fabric piston cups.
Heavy duty ball bearings.
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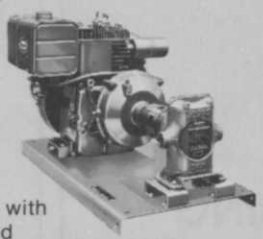
Also available with gas engine and mounting base.

Hypro®
A DIVISION OF LEAR SIEGLER, INC.
347 Fifth Avenue NW, St. Paul, Minnesota 55112

Write **109** on reader service card

Versatile SKY-WORKER fills the bill from tree-trimming to hot line work

Why? Because Sky-Worker can prove cost-savings up to 50% through utilization of its built-in sturdy features and superior manuverability.

Platform stays level under all conditions -dual controls operate unit from work platform or vehicle deck · Fail-safe hydraulic system, combined with optional heat-exchanger requires little warm-up time. Lower boom on Model 1035 moves through overhead arc of 135° degrees · 45 degrees past vertical · horizontal rotation is 400 degrees, 40 degrees beyond full circle.

See how Sky-Worker fits into your maintenance and trouble-shooting work plan. Write for FREE catalog, on your letterhead please.

SKY WORKER

CORRECT MANUFACTURING CORPORATION
London Road Extension
Delaware, Ohio 43015
614-363-1951

Write **150** on reader service card

Products *from page 71*

Adjustable width seeder-spreader applies granulated or drilled fertilizers, lime, sand, or soil for topdressing on golf courses. It gives a thorough coverage, continuous and accurately metered from start to finish, even on hilly fairways. A special key lets the driver adjust spreading width from 20 to 45 feet. Rounded corners keep material from piling up and make it easy to wash out. Models come in hopper loads of 400 to 2,400 pounds from Vicon.

Write 720 on reader service card

The Gandy 30-foot spreader/applicator broadcasts two granular materials simultaneously on 200 acres a day. The 3,000-pound capacity spreader hoppers

and 600-pound capacity optional tandem chemical hoppers that extend time between refills.

Three models are available: 1030A with 1½-inch openings spaced 3⅜ inches apart; 1030B with 1½-inch openings spaced 6¾ inches apart; and 1030C with 1-inch openings spaced 6 inches apart. Spreader and chemical hopper bottoms are die cut as mated pairs and never separated so openings are always uniform at all settings.

Write 721 on reader service card

Brillion Iron Works offers 68-inch Pulvi-Mulchers to crush, harrow, and condition soil in one pass to make a clod-free seedbed that is firm but not compacted. Loose mulch on top slows evaporation. Seed is planted at a uniform depth, in contact with moisture for good germination.

Large diameter roller wheels pull easily. Machine comes with 16¼-inch notched rollers that form pockets to trap moisture or 16½ crowfoot rollers that leave a slightly more open seedbed. Company offers many options to accompany equipment.

Write 713 on reader service card

Put the LAWN GENIE® to work...

and 3 wishes come true.

WISH #1 "I wish I had a tough pick-up mower that would mow and vacuum all in one pass.

WISH #2 "I wish that same pick-up mower would work year 'round thatching, verti-cutting, cleaning up, mowing, sweeping leaves and mulching."

WISH #3 "I sure wish I could change from mowing to thatching blades in less than an hour—with no tools."

IT ISN'T MAGIC! IT'S THE LAWN GENIE.

The one and only tough pick-up mower with patented spring-loaded blades that change in seconds.

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Central South Turf
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Louisville, KY 40213
502-459-2140/2144

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Nashville, TN 37211
615-832-7725

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Storr Tractor Company
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Goldthwaite's of Texas
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817-332-1521
(Dallas - Houston - San Antonio)

Grassland Eq. & Irrigation Corp.
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Latham, NY 12110
518-785-5841

Hector Turf & Garden, Inc.
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Post Office Box 693544
Miami, FL 33169
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Lawn & Garden Supply
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602-278-8585

Lawn & Garden Supply
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602-294-3177

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604-433-2481

Wislar & Company, Inc.
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Atlanta, GA 30336
404-691-4801

Wislar & Company, Inc.
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Homewood, AL 35209
205-942-7888

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M-C MATHEWS COMPANY

LAWN GENIE®

THE PROFESSIONAL'S CHOICE

A Product Of...Mathews Company, P.O. Box 70, Crystal Lake, Illinois 60014

Cut mowing costs down to size. EXCEL HUSTLER 261 runs only 63" wide, mows a 60" swath.

Why haul extra machines or pay extra hours to mow between trees, markers, and the like? One EXCEL HUSTLER 261 with new 3-way deck set for mulch or rear discharge is only 3" wider overall than its 60" cut! Convert deck to side discharge in moments, without special tools.

3WAY DECK

The Mower is EXCEL-easy to operate. Dual hydros work only half as hard, yet direct *instant pure motion* to each drive wheel. A light touch on twin hand levers controls both speed and steering. Belt drive runs straight from engine to mowing deck mounted on the same floating platform. Short wheel base for smooth cut. Tractor comes with 3-way deck.

And More: Edger, Catcher/ Compactor, and Trailer optional. Factory-trained service, genuine EXCEL parts from your EXCEL Distributor. Write for his name and free literature. Or call toll-free (800) 835-3260. In Kansas or Canada call collect (316) 327-4911. EXCEL HUSTLER Turf & Grounds Equipment is built right by Excel Industries, Inc., Box 727, Hesston, Kansas 67062.

GSA: GS-07S-04916 HUD: OPH (CO)m-2930

Mower and More, the choice of the pros.

EXCEL HUSTLER

Turf & Grounds Equipment

Write **132** on reader service card

WT&T CLASSIFIEDS

CLASSIFIED CLOSING DATES:
October issue closes September 4
November issue closes October 8
December issue closes October 30

When answering ads where box number only is given, please address as follows: Box number, % Weeds Trees and Turf, Dorothy Lowe, Box 6951, Cleveland, Ohio 44101.

Rates: All classifications 65¢ per word. Box number, $1. All classified ads must be accompanied by cash or money order covering full payment. Mail ad copy to: Dorothy Lowe, Weeds, Trees & Turf, P.O. Box 6951, Cleveland, Ohio 44101.

USED EQUIPMENT

HI-RANGER 54' and other aerial buckets. 2 Asplundh brush chippers, Prentice hyd. loader, chipper truck, John Bean 20 g.p.m. sprayer, 4 & 9 ton tag-along trailer. Allied Enterprises, Inc., W204 N11509 Goldendale Rd., Germantown, Wi. 53022. Phone 414 255-6161.

HI-RANGERS AERIAL BASKETS 65', 57', 53'. Skyworkers aerial baskets 65', 50', 40'. Vermeer stump cutter 1560, 6. Vermeer tree spade 66, TS 44. Asplundh bucket and brush chippers. Bean sprayer, 9 ton trailer. Parkway Tree Service, 12026 W. Cherry, Wauwatosa, Wisc. 53226. 414 257-1555.

FOR SALE: 78 inch Big John tree mover, serial 32 in good condition, original owner. Trees, Inc. 517 627-9155.

NETSETTER "ROBARK", like new, used on 40 acres. P.O. Box I, Sumner, WA 98390. 206 825-2403.

BRUSH CHIPPERS, used Bean sprayers, Model 10 Vermeer stumpers, Hydro-Axs and bucket trucks. Lease or for sale. Large inventory available. Call or write P. C. Gould Sales Company, Plains Road, Essex, Conn. 06426. 203 767-1636.

MUST SELL—1979 750 gallon spray truck, compartmentalize tank, 100 G.P.M. pump, electric hose reel, like new, $12,000.00 or assume lease. Phone 216 951-5295.

FOR SALE AS A UNIT. 1972 Chev. chipper trucks with steel dump box. 350 engine, 2-speed and powersteering. 20,000 miles. One owner and 1975 Asplundh Whisper chipper. 16 inch, 300, 6 cylinder, Ford engine, low hours. $14,000.00.— 1970 Vermeer stump cutter model 2460, low hours. $7,500.00.— 1973 Vermeer stump cutter model 630, low hours. $4,200.00.— 1974 Elliot, 70 ft. basket truck on C65, Chev. trucks 23,000 miles with extra basket to reach 81 ft. $36,000.00. All equipment is in excellent condition, as I have retired. Call or write Robbins Tree Service, P.O. Box 2116, East Peoria, Il. 61611. Phone 309 699-7920.

LATE 1974 SKYWORKER, 52'; 2 hydraulic limb lopper chain saws, one lopper, mounted on 1974 International Loadstar 1600 1½ ton; 14 cubic yard hydraulic dump box under aerial boom (special order from Skyworker); built in tool boxes; Micro-Lever Lock all-wheel brake, 33,200 miles with 1974 Fitchburg chipper, 12", 749 hours, excellent condition, mechanical and appearance. Call 515 265-4485 day, 515 265-3375 night.

FOR SALE: Three spray trucks, 1976 and 1977 Chevy. C-60's, completely equipped with 1,200 gallon steel tank, mechanical agitation, Bean 20-20 pump, Hannay electric reel, hose, etc. Complete units, excellent condition, ready for immediate use. Will sell separate or special combined price. Phone 502 897-5201 day or 502 896-0879 nights.

FOR SALE: Elgin 81 sweeper $850. 18" Ryan w/roll Ryder $1450. 7 gang Roseman $1450. 73 Chev. 4x4 w/plow control $1450. 10" Parmona 5A mounted pump $1800. Sod by acre. 414 326-5267.

SPRAYER, 1979 Bean Turf Model 1010T, 150 gallon stainless, 500 psi, 10 GPM, flotation tires, like new, $700 below cost. 712 623-9372, Rand Wilson, Box 56, Red Oak, IA 51566.

SIX LOCKE MOWERS with grass catchers. 8 h.p. Briggs & Stratton, 30 inch blade. Excellent condition. Tom Cardi, 133-16 129 St., So. Ozone Park, N.Y. 11420. 212 529-0791.

BOWIE HYDROSEEDER — 3000 gallon mounted on 73 GMC 7500 tandem. Low hours, 15,736 miles. Excellent condition. $36,000. 404 448-5030.

STUMP CUTTER, VERMEER 1560, very good condition. Sheehan Tree Serv., 1944 Ridge Rd., W., Rochester, N.Y. 14626. 716 225-1850.

'79 ASPLUNDH CHIPPER, '79 Chev. ¾ ton, 4x4, 1560 Vermeer stump remover. Call 312 232-9122 (Chuck).

SEEDS

SOD QUALITY Seeds: Adelphi, Glade, Cheri, Nugget, Merion, Fylking, Majestic, Baron & Touchdown bluegrasses, also fine fescues. Manhattan ryegrass. Custom mixing available. Michigan State Seed, Grand Ledge, Michigan 48837. Phone 517 627-2164.

LAWN SEED. Wholesale. Full line of top quality grasses. Improved bluegrass varieties, fine fescues and fine bladed ryegrasses. We specialize in custom mixing. Oliger Seed Company, 2705 Wingate Avenue, Akron, Ohio 44314. Call collect 216 753-2259.

HELP WANTED

CAREER OPPORTUNITY with a sod industry leader. Due to the rapid expansion of our North American sod production capability, The Manderly Corporation is looking for management personnel. If you are interested in a career in agricultural management with an aggressive, fast moving company, we want to hear from you. Apply in writing to: The Manderly Corporation, R.R. 3, North Gower, Ontario, KOA 2TO, Canada. Attention: Alex Baillon, Vice President.

Continues on page 76

When Dave Portz renovated 14 fairways with Roundup®, the members played the same day he sprayed.

Dave Portz
Grounds Superintendent
Brookside Country Club
Mecungie, Pa.

Cleaning up a weedy fairway doesn't have to be a slow, messy job for you—or a hardship for your golfers.

Roundup® herbicide helps make renovation fast and efficient—as Grounds Superintendent Dave Portz discovered last year.

"If we had chosen to plow the course under, we would've had to close it," Dave says. Instead, he applied Roundup on 14 weedy fairways, and reopened the course the same day. While Roundup worked, the members played over the dying turf, with no problems.

The members—and Dave—liked that. They were glad, too, that Roundup won't wash, leach or volatilize to injure desirable plants along the fairway. Dave simply took precautions against spray drift.

This year, reach for Roundup to control many tough weeds. It can make turf renovation fast and efficient for you—and leave a lot more playing time for your golfers.

For literature, call 1-800-621-5800, or in Illinois, 1-800-972-5858.

There's never been a herbicide like this before.

ALWAYS READ AND FOLLOW LABEL FOR ROUNDUP. RI-8011D
Roundup® is a registered trademark of Monsanto Co. © Monsanto Company 1980

Write **126** on reader service card

Classifieds *from page 74*

ADVERTISING SALES POSITION AVAILABLE with a growing specialty agri. magazine, Chicago territory. Requires individual with 1 to 2 years chemical and equipment sales experience in the agri. or specialty agri. market at the distributors level. Ad. space sales experience desirable but not required. Salary plus commission, all expenses, a strong benefit program and plenty of room to advance. Reply to Box 243, Weeds, Trees & Turf, Box 6951, Cleveland, Ohio 44101.

MANAGEMENT OPPORTUNITY—Fast growing, Michigan based firm seeking a creative, self-starting seasoned horticulturalist to assume responsibility for development and implementation of tree and shrub care division. Related product and equipment knowledge imperative. Excellent salary and career growth potential. Send resume and salary history in confidence to Box 244, Weeds, Trees & Turf, Box 6951, Cleveland, Ohio 44101.

FARM ADVISOR — Environmental horticulture and public service—San Mateo/San Francisco Cos. Develop and carry out extension education and research program in ornamental horticulture, turf, Christmas tree production, and roadway brush control. Adopt practices to meet needs of diverse clientele, including youth and other community groups. Disseminate information through all mass communications media; answer questions and provide backup public service information; also meet groups and assist homeowners. M.S. in a plant science preferred with good grounding in horticulture or agronomy; ability to work well with all people under differing conditions essential. Contact: Personnel Office, Cooperative Extension, 331 University Hall, University of California, Berkeley, CA 94720. Closing date: Sept. 5, 1980. Refer to No. 8036. An equal opportunity/affirmative action employer F/M/H.

IMMEDIATE OPENING for 2 experienced persons devoted to the green industry and who take pride in doing a quality job. Salaries commensurate with experience. Spray foreman or forewoman to manage our spray division. Must either have a degree in horticulture or 5 years experience in diagnosis of insects and diseases of ornamentals. Mechanical knowledge required to be responsible for 3-4 sprayers and trucks. Landscape foreman or forewoman to take full responsibility for residential landscapes. Plant knowledge required. Must have an outgoing personality to deal with homeowners. 5 years working experience necessary. Dennis Anderson & Wife, Inc., 312 438-4770, P.O. Box 702, Barrington, IL 60010.

WANTED — Propagator/manager. Large northeast wholesaler in need of full charge propagator capable of reorganizing and managing a propagation department producing broadleaf evergreens, flowering shrubs, coniferous evergreens, and seedlings. Complete responsibility for personnel, systems, and cultural operations. Must have history of managing a large propagation department including budgeting experience, personnel management, and inter-related communications necessary to work within large organization. Salary level allocated for this position designed to attract highly successful manager/propagator type individual. Reply to Box 246, Weeds, Trees and Turf, Box 6951, Cleveland, Ohio 44101.

CAREER OPPORTUNITY with Cemetery Association. Superintendent position. Training or experience in horticulture desirable. Should have knowledge of equipment and grounds maintenance, be able to work with and supervise crew of 5 or 8 men using modern equipment on 125 acres. Deal with public and some lot selling. Salary open, fringe benefits. Send resume to P.O. Box 546, Lima, Ohio 45802.

CITY PARKS AND RECREATION DIRECTOR: Grenada, MS ($ Open). Responsible for all aspects of park, recreation district; its operation and facility function; planning, development, budgeting, financial control, personnel, public relations. Degree in parks and recreation (or equivalent), three years experience in administrative position. Closing date: September 30, 1980. Contact: James J. Turner, P.O. Box 310, Grenada, MS 38901.

JOB OPENING IN HORTICULTURE. Position: Working supervisor and gardener for Kentucky estate. Requirements: Proficiency in horticulture, landscape, greenhouse and garden management. Knowledge of aboriculture and landscape operations highly desirable. References required. For terms and personal resume please contact Mrs. Dillon, P.O. Box 61334, Houston, 77208.

LANDSCAPE IRRIGATION DESIGN and installation. Leading manufacturer of sprinkler irrigation products seeks experienced landscape irrigation design and installation supervisor for 1-year contracts in Saudi Arabia, starting in September. Send resume to: Box 247, Weeds, Trees and Turf, Box 6951, Cleveland, Ohio 44101. Equal opportunity employer M/F/H/V.

LANDSCAPE DESIGNER - SALESMAN. Hustlers only need to apply. Morton Landscaping, P.O. Box 171, Chagrin Falls, Ohio 44022. 216 338-3008.

FOR SALE

VAIL, CO. year-round nursery, snow plow business, located on 1 acre parcel with two commercial buildings, rental income. Includes 3 loaders, 2 dump trucks, 5 pick-up trucks with snow plows. 8 year est. business. 303 476-3433.

ESTABLISHED LAWN & TURF irrigation company in Michigan, machinery, tools, inventory, vehicles, misc. Purchaser shall receive client list and any open contracts at time of sale. Company is very strong in service and installation. Terms available. Reply to Box 248, Weeds, Trees and Turf, Box 6951, Cleveland, Ohio 44101.

ESTABLISHED LANDSCAPING BUSINESS—$60,000 volume, all equipment, trained employees, satisfied clientele. High potential, excellent reputation. Jim Drake, Zanesville, Ohio. 614 454-1684.

FOR SALE—3 gang Toro Spartan mower & frame, rubber tires, new, still in crate. No reasonable offer refused. 1977 Jacobson 70 inch trimmer, excellent condition. Call 308 262-1537.

SPRAYERS — FACTORY DIRECT, professional gardeners, turf applicators, proven dependability, unconditionally guaranteed. Black River Sprayers, Box 824, Andrews, S.C. 29510.

BUSINESS OPPORTUNITIES

LEARN LANDSCAPING and the growing of plants at home. Start a satisfying business or hobby. Free booklet. Lifetime Career Schools, Dept. A-828, 2251 Barry Avenue, Los Angeles, Ca. 90064.

WANT TO BUY OR SELL a golf course? Exclusively golf course transaction and appraisals. Ask for our catalog. McKay Golf & Country Club Properties, 15553 N. East Street, Lansing, Michigan 48906. Phone 517 484-7726.

ESTABLISHED LAWN & TURF irrigation company in Michigan, machinery, tools, inventory, vehicles, misc. Purchaser shall receive client list and any open contracts at time of sale. Company is very strong in service and installation. Terms available. Reply to Box 249, Weeds, Trees and Turf, Box 6951, Cleveland, Ohio 44101.

MISCELLANEOUS

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